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Learners' motivation to collaborate in online learning environments

A situational and social network analysis

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Tiivistelmä - Referat - Abstract

Learning in collaboration with others with the support of a computer has been found to improve learning results and increase learner satisfaction in comparison to other methods of learning online, when implemented successfully. Many studies have, however, found that it is common that there is very little social interaction when learning online. This has been shown to be related to students dropping out, low levels of motivation and generally fails to harness the benefit of learning in collaboration with others.The aim of this study is to analyze learner's motivation to collaborate in an online course. Some studies regarding the motivation to collaborate exist in the tradition of computer-supported collaborative learning (CSCL) but very few have taken into account the situational nature of motivation.

The participants in this study were students taking part in an online course on responsible business at a university in Finland (N = 179). Their motivation was sampled by triggering the Situational Motivation Questionnaire (SIMS) when they performed collaborative acts, using what is termed context-sensitive ecological momentary assessment. The students' patterns of interaction were studied using social network analysis based on their use of the chat function afforded by the learning platform.

Students were found to experience more extrinsic than intrinsic forms of motivation to collaborate on a situational level. Motivation did not appear to be affected by progression in the course or deadlines. Participation in the social interaction was moderately high, varied a lot from student to student and appeared to be clustered to sub-groups within the social network. Intrinsic motivation was more likely to be experienced in positions of lower centrality and betweenness in the social network. Due to there being very little earlier research into this topic using similar methods, these results provide important new insights into why students collaborate in an online environment.

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Datorstött kollaborativt lärande, situerad motivation, lärande samfund

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I jämförelse med andra former av lärande på nätet, har datorstött lärande i samarbete med andra har visats förbättra lärande resultat och tillfredställelse då det lyckas. Många studier har dock visat att social interaktion i lärande på nätet är sällsynt, vilket har samband till dropout, låg motivation och förlorar nyttorna av kollaborativt lärande.
Strävan med denna studie är att analysera studenrandes motivaton att samarbeta under en kurs på nätet. Få studier finns om motivationen att samarbeta i datorstött kollaborativt lärande och ännu färre har tagit i beaktande motivationens situerade natur.

Deltagarna i forskningen var studeranden som var med i en kurs om ansvarsfull handel på ett universitet i FInland (N = 179). Deras motivation analyserades genom att automatiskt be dem fylla i ett mätinstrument (Situational Motivation Scale) då de betedde sig kollaborativt. Sociala nätverket som uppstod ur deras samarbete härleddes ur hur de använde chat-funktionen som fanns på lärplattformen.

Studerandena upplevde mer externa än interna former av situerad motivation för att samarbeta. Motivationens slag påverkades inte av kursens framfart eller deadlines. Studerandena deltog relativt ofta i social interaktion men det varierade mycket mellan studeranden och formade mindre grupper bland kursens deltagare. Interna former av motivation upplevdes mindre sannolikt i centrala eller "betweenness" centrala positioner i sociala nätverket. Det finns bara lite forskning om detta tema som har använt motsvarande forskningsmetoder. På grund av detta ger forskningens resultat viktig information om varför individer samarbetar då de lär sig på nätet.

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1. Introduction

A variety of studies conducted in the last decades highlight the importance of collaboration and social interaction for learning results (Johnson & Johnson, 1999). In short, learning together with others, enables us to attain levels of knowledge and skill that would otherwise be out of reach, while making learning more motivating and enjoyable (Ryan & Deci, 2000).

In spite of this, educational institutions still commonly employ learning methods that don't encourage collaboration among learners and rely solely on material created by the teachers. They have, in accordance with traditions spanning hundreds of years, favored methods that allow clear measurement of individual performance and discipline over methods that encourage collaboration and self-organization (Gee, 2005). Because of the lack of encouragement and support for social learning, it is common that learners don't collaborate, unless it is explicitly required (Guzdial & Carroll, 2002).

This is not only true for institutional teaching (such as in the classroom) but is even more emphasized when learning online. In an online context, the dominant way of learning is individual work and material and assignments given by the organizing party (Scardamalia & Bereiter, 1994). This can make learning alienating and performative, a process carried out separate from the support and engagement of a social context.

The consequence of this is that dropout rates in a given course can be up to 97% and satisfaction among learners is, on average, quite low (Scardamalia & Bereiter, 1994, 2006). Even though there has been an overwhelming body of evidence describing the benefits of social learning, there is a clear gap between what research knows and how courses and other learning processes are carried out, both online and off.

The advent of online collaborative tools and virtual environments have in recent years shown that technological tools can, at best, be a means for better learning. They have shown that knowledge sharing and creation in groups are key for both

organizational productivity (Brown & Duguid, 1991; Wenger, McDermott & Snyder, 2002) and individual learning results (Scardamalia & Bereiter, 2006). The tools have allowed groups of learners to create, share and maintain knowledge in a way that is possible for large group sizes and doesn't require physical presence.

It is important to note that these new tools and systems themselves do not, however, guarantee a positive outcome and can even hinder fruitful social learning, if they are not aligned with positive social practices that the learners and teachers employ (Kirschner, Sweller & Clark, 2006). In essence, we cannot assume that knowledge practices will become more social by simply being exposed to social tools or that all changes caused by technology are positive. As Hakkarainen et al. (2006, p.608) stated; "...technology-enhanced learning transforms educational practices only through transformed social practice". So far, interaction in online learning has been very rare and much scarcer than in traditional face-to-face learning (Guzdial & Carroll, 2002).

The technology is not a guarantee but it can, when designed and introduced correctly, support a transition into a more social way of learning (Scardamalia & Bereiter, 1994, 2006; Dillenbourg, 2016). The aim of this transition is characterized by learner-driven collaboration that builds new knowledge (Paavola & Hakkarainen, 2009). These collaborative modes of learning are characterized by learners creating and advancing learning objects (such as texts, plans and norms) together and communicating through them (Paavola & Hakkarainen, 2009). They create content together and through that process, advance each other's learning in a way that is engaging, autonomous and productive (Blumenfeld, Kempler & Krajcik, 2006).

The transition into collaborative modes of learning has proven to be difficult in many cases, due to learners being socialized into a learning culture of centralized content creation and externally directed inquiry during the years of their formal education (Scardamalia & Bereiter, 1994). Collaborative learning methods often require learners to direct their own inquiry and create or at least discover much of the learning content (Scardamalia & Bereiter, 2006). Because the traditional

and collaborative ways of learning are so different, learners require re-socialization in order to be able to adopt this new mode of learning. This, as most changes in behavior, is driven by the learner's motivation to change their way of learning.

In order to cultivate collaborative learning practices and build technological tools that support effective collaborative learning, we need to better understand what motivates learners to change their current way of learning and transition into more social practices and tools. In an online and blended learning context there is some research into the process as a whole, but the motivational aspects have been almost completely ignored (Dillenbourg, Järvelä & Fischer, 2009). This remains one of the main contemporary topics of research on how to make online learning work as motivation has been identified as a decisive factor of the success of online courses (Muilenburg & Berge, 2005).

The goal of the present study is to analyze learner's motivation to collaborate in an online learning context. Both situational experiences and the collective level of collaborative learning are analyzed in a higher education context.

2. Theoretical frame of reference

The main themes of the theoretical frame of reference in this study are collaborative learning, motivation and computer-supported learning.

This chapter is structured as follows: It starts with a brief discussion of how learning is viewed through metaphors that contain implicit assumptions about the process (chapter 2.1). This lays the foundation for the next segment, which describes fruitful collaborative learning on a group level (chapter 2.2), followed by how it can be realized when mediated by computers (chapter 2.3). After this, the motivational aspects of learning are described first on a general level and then in relation to collaborative learning (chapter 2.4). The final segment of the theoretical frame of reference unites the aspects on collaborative learning, motivation and computer-supported learning describing relevant research results on the topic of this study (chapter 2.5).

2.1. Metaphors of learning

In order to understand modern collaborative learning practices in an online context, an understanding of their foundations is required (Paavola, Lipponen & Hakkarainen, 2002). The learning practices and how they are studied are based on some implicit or explicit epistemological assumptions of what is considered learning and what a community of learners is like. This chapter briefly describes the epistemological foundation that underpins the research of contemporary collaborative learning in an online context.

Traditionally, knowledge has been seen an object held in the mind of individuals, capable of being replicated and transferred into the minds of others by communication (Sfard, 1998). It has been (and still is by many) considered a self-contained entity that is acquired from the environment by the learner and placed in the container that is their brain. This has been termed the **acquisition metaphor** of learning.

The problem with this acquisition-based metaphor of learning, is that in practitioners' minds it will often be taken too literally and they will assume that "gaining knowledge" has the same properties as physical objects or materials that are

moved (Sfard, 1998). This assumption contains a range of fallacies and negative norms, such as thinking a piece of knowledge will remain an immutable object in the mind of its owner independent of experiences or hoarding pieces of information as possessions rather than sharing them (Sfard, 1998). In addition, it does not explain the positive learning results found in peer learning and undermines the meaning of social aspects during the learning process (see later chapters). This metaphor of learning also has (arguable more foundational) problems in the inconsistencies it has in a philosophical sense, which will not be covered in this thesis because they hold little practical relevance for the following chapters. Those interested can see Sfard (1998) for a discussion.

As a remedy to these problems of the acquisition metaphor of learning, theorists have suggested a second metaphor of learning that emphasizes the participation in social activity (Koschmann, 1999). In this **participation metaphor**, learning is considered a dialogical activity between individuals where the knowledge is dependent on how an individual interacts with their environment (Sfard, 1998). This shifts the location of the learning from the cognition to the interaction between the individual and other people. Consider for example a situation where one student in a group makes a claim about their view of some concept, another student then questions their view which causes the first student to provide an argument supporting their claim. Here, both of students are likely to have a slightly altered understanding of the concept just because they participated in the interaction. Equally, other students who had different discussions or only listened to given information will have a different view of the concept. The same principle of social construction of knowledge applies when the interaction is through an object, such as a book, where the learner's own internal dialogue with the information presented will determine their learning (Sfard, 1998). In this metaphor of learning, there is not a clear divide between the person "providing" knowledge and the one "attaining" it; both will be altered by the interaction (Koschmann, 1999).
In the participation metaphor, knowledge is not an object held by the individual but subject to the activity of *knowing* it, meaning interactive activity is required for knowledge to exist (Sfard, 1998). To put it differently, knowledge is relative to the norms of the surrounding community and the participation in its learning activity (Paavola et al., 2002), because that is where it will have an impact on others and

where it is understood and built upon. This view of learning is manifested in the communities of practice, discussed in chapter 2.2.

Both of the metaphors discussed above (acquisition and participation metaphors) have their strengths and scientific basis for existence, but are not an apt framework of analysis for the contemporary learning communities where the social structure and knowledge is continuously shifting (Paavola et al., 2002). Only focusing on the objects of knowledge acquired by cognitive processes disregard the social nature of that knowledge. On the other hand, considering knowledge a property of the interaction will undermine the value of the knowledge artefacts that are created.

As a synthesis of these two views, Paavola et al. (2002) suggest a **knowledge creation and development metaphor** of learning to describe modern learning communities. In this metaphor, learning is seen as the creation and development of knowledge artefacts through collaboration (Paavola et al., 2002). Even when learning something that has been presented by a teacher, the learner will discover that information and link it to things they consider relevant in their previous knowledge. They will essentially create that knowledge for themselves when they are learning and may even develop the original concept further.

Although not all learning is knowledge creation (consider for example learnt reflexes and subconscious learning), this type of fluid communal advancement of knowledge is becoming an increasingly apt description of the type of learning happening in universities, in the workplace and online (Wenger et al., 2002; Gee, 2004; Paavola et al., 2002). Our rapidly changing environments requires more dynamic forms of learning progress, than simply attempting to ingest information discovered by those who came before us.

Although the relevance of the metaphors of learning for the present study may seem questionable, how one chooses to see learning determines what they consider the goal of improvement. A teacher that has embodied an acquisition metaphor of learning is likely to construct a course that aims to students retaining as much knowledge as possible. On the other hand, a teacher whose view corresponds to the participation metaphor, will try to foster a high level of participation and a strong sense of community in the group.

The next chapter will provide a description of what the knowledge creation metaphor can consider an optimal social arrangement and later chapters detail what sort of learning is desirable on an individual level.

2.2. Collaborative learning in groups

Not all learning done together with others can be considered collaboration. Often times a learning process emphasizes individual activity so much, that learners simply coexist and only occasionally interact (Johnson & Johnson, 2009). Although there is an obvious social component in the presence of others, the learning itself is not collaborative.
In other situations, seemingly collaborative tasks (such as group assignments) are gone through by just coordinating practicalities and individual efforts among members and combining them at the end, without ever discussing the content itself. This characterizes cooperative learning, but not collaborative.

In order for a learning process to be considered collaborative, and for it to yield the benefits of collaborative learning, learners need to discuss and reflect on the content itself together and work towards a shared conception of the matter at hand (Stahl, Koschmann & Suthers, 2006). This involves dialogues, analysis and argumentation with the aim of having shared meanings of things relevant for the task.

This chapter describes some theoretical frameworks that have been used to describe large groups of collaborative learners in recent years. This will yield a framework for analyzing how collaborative learning occurred in the setting of this study and describing a desirable state of collaborative learning on a community level.

Several different theoretical frameworks and terms have been used to describe sets of people who are engaged in a collaborative learning activity. Terms used to describe these sets have included community of practice (Lave & Wenger, 1991; Wenger, 1998), innovative knowledge community (Hakkarainen, 2009), (online) learning community (Maor, 2003; Brown, 1994), community of interest (Newman, 1980), network of practice (Brown & Duguid, 2002) and simply group.

All of these fit the purposefully loose definition of “set of people learning together” mentioned above, and have some level of overlap in meaning with one or more of the other terms. There are, however, clear differences in what sort of collectives they describe, whether or not collaboration is emphasized and which factors in the learning process they focus on.

In this section communities of practice will first be discussed as a description of a collaborative learning community. After this, the theoretical frame of reference is expanded upon with Gee’s theory of *affinity spaces* which arguably is an extension of Wenger’s (Lave & Wenger, 1991; Wenger, 1998; Wenger et al., 2002) original theory of communities of practice.

Affinity spaces and communities of practice are especially suited to describe the fluid collaborative structures that arise in contemporary online courses and have been increasingly relevant to describe new forms of social organization emerging in recent years (see below). Due to this, communities of practice and affinity spaces from the theoretical basis of social learning on a community level in this study.

2.2.1. Communities of practice

The term *community of practice* has been very popular in the field of social learning since it was coined (Cox, 2005) and has since been applied to research in several different domains, including organizational learning, higher education and informal learning (Wenger et al., 2002). Some applications to research on online learning also exist, but the theory has some limitations in regards to its aptitude for this (discussed at the end of this section).

Formally a community of practice is defined as “a group of people who share a concern or a passion for something they do, and learn how to do it better as they interact regularly.” (Wenger-Trayner, 28.11.2011). How Wenger’s and Lave’s (1991) definition differs from other terms that describe learning groups or collectives, is that it recognizes more informal and ubiquitous forms of learning and

participation (note the comparison to metaphors of learning). Educational institutions are, according to the theory of communities of practice, only one of the places where learning happens and self-organized forms of learning are the desirable state.

The idea for communities of practice originally arose from Jean Lave and Etienne Wenger's (1991) studies of apprenticeship teaching. They used it to describe the group or practitioners (or community) into which a newcomer is introduced and progressively becomes more assimilated with by observing and interacting with other members (Lave & Wenger, 1991). These communities are, according to the theory, defined by three factors: *joint venture*, *mutual engagement* and a *shared repertoire* (Wenger, 1998).

The *joint venture* is the goal or domain of knowledge which the members of the community are aiming to progress (Wenger, 1998). This can, for example, be related to professional development or improving data privacy policies in a specific country. In an institutional online learning context, the joint venture can be to deepen one's own knowledge of the subject area. It is important to note that although Wenger et al. (2002) refer to this as a shared goal, members of the group are likely to have a slightly different view of what that goal is. New members are especially likely to have a different view of what the community of practice is working towards, but often internalizes the majority view as they interact with other members over time (Wenger, 1998).

In addition to this, communities of practice are defined by *mutual engagement,* which refers to the interaction among members of the community (Wenger, 1998). This means that in order to qualify as a community of practice, a set of learners have to interact directly with each other and not just through knowledge artefacts which they have created. The mutual engagement results in social ties among the members and deepened consensus on the nature of the common endeavor (Wenger, 1998).

The last integral factor of a community of practice is, according to Wenger (1998), a *shared repertoire* which constitutes all the resources the community has, defined both literally and figuratively. This includes tools, stories and solutions to recurring problems. In essence, it is the knowledge and skills that is common to the members of the community and which they have accumulated (Wenger, 2011). For a collective of students in an online course, this could refer to terms and concepts they have learned during the course or processes they use for group work, but also inside jokes and slang.

Practical features of a stereotypical community of practice is that they lack formal organization and hierarchy, organizing only around the topic. They rarely have any formal leaders or governance processes, but may have recurring behavior such as weekly meetings or named moderators of some common resource. Communities change and adapt as their view of the joint venture develops but often have a relatively stable goal (Wenger et al., 2002). Examples of “pure” communities of practice are open Facebook-groups where individuals discuss and share links on a specific topic and networks of researchers interested in the same area who sometimes meet and organize conferences.

Communities of practice have been very successful configurations of learning in a both institutional and informal learning context (Wenger et al., 2002). Especially companies, such as IBM, have made great efforts to spawn and support communities of practice because they have realized their scalable advantages which most often require very few material resources, if any (Wenger et al., 2002). This is due to the fact that they inherently oppose costly traditional management activities and other centralized efforts required to uphold other forms of organization that produce learning.

The main benefits of communities of practice are that they are especially suited for learning in a turbulent knowledge economy (Wenger et al., 2002). It is impossible to predict what type of knowledge will be required to solve the novel problems which arise at an increasingly rapid pace. Thus the ideal structure in the new context is reactive and adaptive to changes while effectively disseminating lessons learned from and to any part of the network of learners.

Since the inception of communities of practice as a theoretical concept in the early 90's, online learning and computer supported social interaction have become much more common and their structure has developed. It is now common that we are peripheral members in many different communities both offline and online (Gee, 2005), engaging in their activity now and then, only following from the sidelines or just for a brief time. Think, for example, of how many Facebook-groups an average user is a member of, or how many projects knowledge workers in large corporations are engaged in. This change in social organization does not mean that the membership-, identity- and engagement-focused theory of communities of practice has become irrelevant, but that it is not as apt to describe these new social processes.

Wenger (2011) and other scholars (see for example Dubé, Bourhis & Jacob, 2005; Kietzmann et al., 2013) have in recent years developed the theory of communities of practice further to better fit the changing landscape of learning and collaboration. It is still, however, problematic to focus on processes of identity and membership in collective when participation is minimal, temporary and ever-changing. Other theories (see next chapter) are arguably better suited to describe these new forms of learning and collaboration such as the learning process in an online course.

The community of practice framework is still useful for analyzing the learning happening on an online course, because learners are likely to self-organize to some extent. It is common for students to form informal study circles, share material from outside the official curriculum and to have different levels of knowledge among peer learners. The popularity and fairly long history of communities of practice as a concept make it a more extensive and polished framework than the one discussed in the following chapter. It is, however, clearly more aligned with the participation metaphor of learning that the the knowledge creation metaphor, which creates limitations in its ability to analyze knowledge artefacts and knowledge building activities.

2.2.2. Semiotic Social Spaces and Affinity spaces

As a development out of the limitations of a community of practice described in the previous section, James Paul Gee (2004; 2005; Gee & Hayes, 2012) and his colleagues postulated the theory of *semiotic social spaces*. It has some commonalities with the 'communities of practice' framework, but has a shifted its focus of analysis and differs in how it is defined.

Instead of focusing on the relationships and definitions of membership in learning collectives, Gee (2005) focuses on the *space* in which learners interact.
The space, to which Gee (2005) refers, doesn't only connote a physical space of learning, such as a classroom, but also the virtual or communicative space in which the learning happens. Seminar halls, online chat rooms, mailing lists and online multiplayer games are all spaces in this sense. This is more clearly aligned with the knowledge building metaphor of learning, whereas the community of practice theory focuses on participation (see chapter 2.1.).

Gee (2005) argues for this shift in focus by pointing out that using the term *community* implies stronger relationships than those found between learners in many contemporary contexts. A group of people who play an online multiplayer game together for an hour hardly qualify as acquaintances, even though they may have learned, interacted and shared a common goal for that period of time.
Considering the community as a group also suggests that membership is binary, meaning you either are a member of it or you aren't (Gee, 2005). This dichotomy is difficult to apply analytically to a learning context where no clear boundaries exist. Consider for a moment the membership status of someone who sporadically reads a web forum dedicated to learning some skill. Are they then part of the community even though the communication is in only one direction? What about a person who plans and creates the course curriculum but does not participate in the learning activities? Their influence on the development and interaction is undeniable but they, as an individual, are secluded from it. It is then problematic to think of these fluid wholes as "communal" in the traditional sense of the word.
The same applies for students attending an online course. In this case it is much easier to define who is and who isn't "a member", but the same lack of community

and (all too often) social engagement is still present. Membership in the group of students attending an online course, is perhaps not best seen as an expression of identity as Wenger (1998) suggests.
Analyzing the space, instead of thinking in terms of membership, shifts the focus from matters of identity to the primary interest or aim that drives the learners and where and how it is expressed. This is practical for researching collaboration in an online context and, as stated earlier, focuses on the visible acts of developing knowledge further.

It is possible to analyze almost any physical and virtual space as a semiotic social space, but not all are affinity spaces. In Gee's (2004) framework, the optimal type of semiotic social space for learning is an *affinity space*. Affinity spaces are defined as, "...a place or a set of places where people can affiliate with others based primarily on shared activities, interests, and goals, not shared race, class, culture, ethnicity, or gender." (Gee, 2004, p.67). Learning in affinity spaces is then much more reminiscent of informal learning and driven by autonomous interest (meaning intrinsic motivation) than learning commonly is in learning institutions.
Optimally, affinity spaces embody a set of features that nurture individual's learning in a decentralized and fluid manner (Gee & Hayes, 2012). The best affinity spaces, according to them, embody characteristics such as a common endeavour, avoid segregation of learners by age or skill, encourage participation and knowledge building, foster dispersed rather than centralized knowledge and employ situational leadership (Gee & Hayes, 2012). In such a community, learners' roles fluctuate and peers are the main source of feedback.

Upon considering these characteristics, it is easy to see a sharp contrast between optimal affinity spaces and the way online learning traditionally happens. Situational leadership and expertise is encouraged, which is not the norm in for example universities. The same is true for the dynamic, interest driven topic selection and exploration that affinity spaces encourage. Most online courses that have a predefined curriculum and scheduled learning activities (essays, quizzes etc.), set the "learning path" for each student clearly do not fill many of the criteria of an optimal affinity space.

The degree to which online courses resemble optimal affinity spaces varies a lot. As of late there have been some Massive Open Online Courses ([MOOCs]) employing a less structured approach to online learning. In these the roles of teacher and student are situational and the curriculum is negotiable, which has clearly parallels to the definitions of communities of practice and an affinity space (see above). These less rigid courses have been dubbed cMOOCs, short for connectivist MOOC (for a list of examples, see http://www.connectivistmoocs.org/). Although there are trends of more socially focused and less structured learning, the traditional mode of online teaching is, however, still clearly dominant independent of the domain.

As is consistent with the research on intrinsic motivation in learning (see chapter 2.4.1), Gee (2004) states that affinity spaces create a context that fosters learners' motivation to be engaged over a longer period of time, autonomy and self-directed inquiry. Affinity spaces aim to harness the learner's own interest toward the topic and cultivate engagement over time.

Because affinity spaces as a framework highlight the basic tenants of motivation (see chapter 2.4) through encouraging self-direction, social interaction and deepened knowledge, they are not only optimal for the community and the topic which is being advanced but also for the needs of the individual learner. In summary, semiotic social spaces and affinity spaces provide a description of one type of optimal learning on a community level that is suitable for contemporary models of learning in large groups.
The next chapter describes how learning among community members can happen effectively when assisted by computers.

2.3. Computer-supported collaborative learning

Learning in collaboration with others with the help of computers shares many similarities with doing the same face-to-face, but is considered its own field of research within the learning sciences because it has been shown to have its own distinctive intricacies (Stahl et al., 2006). The affordances that computers offer

for shared learning, such as creating shared objects and communicating asynchronously, cause computer-supported learning to be distinguished from face-to-face learning from a research perspective (Järvelä et al., 2015). This chapter provides an account of how effective collaborative learning happens when mediated by computers.

2.3.1. Challenges of traditional ways of learning online

Although learning with the help of computers and the internet is becoming more and more prevalent, learning and teaching with technology is still found to be very difficult (Stahl et al., 2006). Online courses suffer from extremely high dropout rates due to problems with motivating students (Muilenburg & Berge, 2005). In addition, social interaction is much less common in online learning environments than it is face to face, in spite of it being a major component in effective learning (Guzdial & Carroll, 2002).

Scardamalia & Bereiter (1994) summarized the problem with how computer-supported learning has been implemented, as copying the traditional methods of learning in person and using computers for it. Recreating the same pedagogical patterns and assuming it to be more effective due to higher availability of information with less teacher involvement were common fallacies during the 1990's (Stahl et al., 2006). This disregard for the social and motivational context of learning has caused computer-aided learning to be criticized as mechanical and isolating for the individual learner (Stahl et al., 2006).

Although the methods have progressed in the last two decades, it seems the applications of online learning are still suffering from many of the same problems (Stahl et al., 2006). Simply making more carefully designed information available to learners in schools and organizations is unfortunately not answering the ever shifting societal needs, where memorization holds less and less value while increasingly complex and novel problems need solving (Scardamalia & Bereiter, 2006). The contemporary society and workplace needs collaborative knowledge creation and creative problem solving more than it needs individually held pieces of information (Scardamalia & Bereiter, 2006; Wenger et al., 2002).

2.3.2. Productive computer-supported collaboration

Dillenbourg (2016) points to a trend of online learning becoming more and more social to satisfy the individual and societal needs in learning. The technologies meant to aid learning are being more influenced by social media in the sense of increased autonomy, interaction and social cognition (Dillenbourg, 2016) while still needing "skillful planning, coordination and implementation of curriculum, pedagogy and technology" in order to make the interaction productive and stimulating (Stahl et al., 2006, p.411).

It is in this aim of more learner-driven, effective and social learning, that the field of computer-supported collaborative learning is engaged (Stahl et al., 2006).

Although there are several fields that study learning with computers, the strand of research most focused on collaborative forms of learning, is termed computer-supported collaborative learning [CSCL] (Dillenbourg, 2016). The field of **computer-supported collaborative learning is concerned with designing and studying education where technology-mediated social interaction among peers is the most central component of learning** (Dillenbourg et al., 2009, p.3). CSCL studies how peers create meaning together with the help of technological artefacts, not just focusing on online learning but on any context where these artefacts are present (Dillebourg et al., 2009; Koshmann, 2002).

Stahl et al. (2006, p.420) summarizes the pedagogical view of computer-supported collaborative learning in saying that "learning is not merely accomplished interactionally, but it is actually constituted of the interactions between participants". As in the participation and knowledge creation metaphors of learning (see chapter 2.1.) learning is then not considered a property held by individuals and focusing only on their cognition, but on the collaborative activity and shared sense-making that happens among learners (Stahl et al., 2006). This stands in contrast with traditional views of learning summarized in the acquisition metaphor of learning, which focus on individuals' abilities and the measurability of their results (Scardamalia & Bereiter, 2006).

CSCL seeks to achieve engagement and cognitive performance by stimulating knowledge construction on a collective level (Järvelä et al., 2015). This is done through facilitating collective inquiry into different topics, which means that groups of learners work in a similar manner as someone who is researching a topic that is unknown to science (Scardamalia & Bereiter, 2006). Students are not simply handed pre-analyzed wholes of information but are directed in a way in which they construct their own knowledge of the topic at hand in collaboration with others.

This method is based on the assumption that high quality learning is psychologically a very similar process as creating completely new knowledge (Scardamalia & Bereiter, 1994). Finding things out together with others is more engaging and contextualized, because then students are not merely passive recipients, nor active analysts of information but they “invent” their own knowledge (Scardamalia & Bereiter, 1994; Scardamalia & Bereiter, 2006; Dillenbourg et al., 2009). As Scardamalia & Bereiter (2006, p.102) put it, “[a]ll understandings are inventions”.

Compared to traditional online learning, where the primary interaction happens between the system and the student, computer-supported collaborative learning emphasizes social interaction between peers and between students and teachers (Dillenbourg et al., 2009). This shift is based on research showing that collaborative learning most often has a significant advantage over individual learning in several contexts (see Johnson & Johnson, 1999 for a review) and the consistent past disappointments in the promises that a new medium will improve learning results (Dillenbourg et al., 2009). Although the content and the technology at hand is important, they will not determine the quality of learning in the view of CSCL - learning is determined by the process and effort with which the shared knowledge is constructed (Dillenbourg et al., 2009).

Although the social aspects of learning are emphasized in CSCL, collaborative learning is not considered a “silver bullet” that always is followed by high quality learning. There are differences in the extent to which different kinds of collabora-

tion produce positive outcomes. As Dillenbourg et al. (2009, p.6) stated, the results “depend upon the extent to which groups actually engage in productive interactions”; *productive* being the operative word.
For the discourse to be knowledge-building, it needs to aim for shared understanding, be directed by the learners themselves and be progressive; building on previously created knowledge (Scardamalia & Bereiter, 1994). Collectives that embody these characteristics are considered knowledge building communities (see previous chapter).

In this type of online pedagogy, the teacher’s role shifts from being the source of information to a facilitator of learning (Blumenfeld et al., 2006). Dillenbourg et al. (2009) likened the role of the teacher to an orchestrator, which is someone who directs the learning process and makes supportive interventions while not being the center of the activity. Contrary to the views of the online pedagogy of the 1990’s (and perhaps an intuitive assessment), this means that the teacher’s importance **increases** in online learning (Dillenbourg, 2016). In practice, this means that the teacher is responsible for creating such a context that encourages productive interaction and for keeping the process on track towards collective and individual learning. This happens through educating the students in methods of inquiry and positive collaboration, designing tasks that support positive interdependence, aiming students inquiry towards the topic at hand and following the learning process as it unfolds, making interventions (encouraging, challenging, suggesting etc) where needed. The teacher does not provide all the resources, evaluation, goals, and strategies but supports the process in which the learners create and discover these on their own. The teacher’s role is to provide scaffolding for the learning process.

This level of learner-directedness is probably not suitable for all situations and will require teachers and students to unlearn a lot of what they are used to. It has, however, proven to increase motivation and cognitive engagement during the learning process (Blumenfeld et al., 2006; Järvelä et al., 2015). In addition, educators can determine the level to which the learning situation supports what is called *epistemic agency*, which connotes the “amount of individual or collective control people have over the whole range of components of knowledge building

- goals, strategies, resources, evaluation of results, and so on." (Scardamalia & Bereiter, 2006, p.107). Increasing the level of epistemic agency in the learning environment is likely to increase motivation and cognitive engagement, even if the environment as a whole doesn't match what CSCL researchers consider an optimal learning environment.

In CSCL research there is less and less separation between the virtual and physical environments and the line between is becoming more and more blurred as technology becomes increasingly ubiquitous (Dillenbourg et al., 2009). To the learner, the virtual and physical spaces are both simply a part of the learning environment as a whole.

Technology can, however, support the improvement of a predominantly face-to-face learning experience that could be carried out even without these tools. This requires the tools to be supportive of positive social patterns (Stahl et al., 2006). Dillenbourg et al. (2009, p.6) summarized the purpose of the virtual environment, as "*to create conditions in which effective group interactions are expected to occur."*

Although CSCL researchers routinely state that no technology has the capacity to change practice (Stahl et al., 2006), the affordances (opportunities for actions) they offer determine how the tools are used and - at least to some extent - how we learn and interact with them and each other (Järvelä et al., 2015)

2.3.3. Opportunities and challenges of using technology in knowledge building

Technology, and especially virtual learning environments, can encourage knowledge building in many different ways (Scardamalia & Bereiter, 1994, 2006; Dillenbourg et al., 2009).

Often in blended learning (meaning settings where learning happens both with the aid of computers and face-to-face), online environments can be a place where the learning efforts that have been carried out face-to-face are stored and combined (Scardamalia & Bereiter, 2006). Online environments can, alternatively, be a place for students to create, share and develop knowledge artefacts further, spanning the whole knowledge building process (Scardamalia & Bereiter, 1994,

2006). The trend is, that online learning environments are becoming more susceptible to students own resources and content instead of just being a place to retrieve material provided by the teacher (Dillenbourg, 2016). They are becoming more and more supportive of knowledge creation and development driven by the learners themselves.

The collaborative virtual environment should, in the view of Scardamalia & Bereiter (1994), provide a place of free information flow, where students can share resources and ideas to each other without having to be “approved” by a teacher or administrator. When they have been added, they should be available for commenting, revision and reuse by peers (Scardamalia & Bereiter, 2006). These artefacts are most likely to be documents in most contexts, but concept maps, graphs and links should also ideally be supported (Scardamalia & Bereiter, 2006).

In addition to storing, working on and using knowledge artefacts, virtual learning environments can support knowledge building by supporting different types of interaction among learners. Asynchronous and synchronous discussions should both be supported, preferably both as text and speech because they serve different types of discussion. Synchronous discussion is more direct and spontaneous, whereas asynchronous discussion is more contemplative (Scardamalia & Bereiter, 1994). Small group interaction is claimed to be the most important, but the fruits of discourse should be easily shareable to the whole group (Scardamalia & Bereiter, 1994). Positive patterns of interaction can also be supported by automatic interventions and affordances provided by the online environment (Dillenbourg et al., 2009), by for example suggesting message formats or automatically analyzing the discussion and giving feedback.

Although CSCL can produce both positive learning results and positive affect, the results of case studies have shown that the involvement of technology can have a neutral effect or even hinder learning (Blumenfeld et al., 2006). The main barriers to these positive outcomes are lacking social interaction and negative social phenomena such as conflict and bullying (Dillenbourg 2016; Dillenbourg et al., 2009; Kreijns, Kirschner & Vermeulen, 2013).

In recent cases, for example, student dropout in online courses has been predicted by a lack of social engagement (Wen, Yang & Rosé, 2014; Sinha, Jermann, Dillenbourg, 2014). It is not uncommon that there is so little social interaction among learners in a virtual environment that no learning is expected to happen, even when interaction is afforded by the environment (Caspi, Gorsky & Chajut, 2003; Guzdial & Carroll, 2002; Dillenbourg, 2009; Kreijns et al., 2013).

Kreijns et al. (2013) summarize, that a positive social space has to arise within the group for CSCL to be effective. This positive social space is, in their view, created by the affordance of positive social interaction in the environment, trusting and strong interpersonal relationships among learners and the extent to which people experience each other as being “real” people in the virtual environment (Kreijns et al., 2013).

Computer-supported collaborative learning is, in summary, a discipline that differs from traditional classroom learning and has many opportunities for fruitful and pleasant learning. For these to be realized, the learning should be learner-directed and consist of collaborative knowledge build among peers. At its core, successful CSCL is determined by effective collaboration patterns among learners, which are affected by the teacher and the learning environment. Technology plays a significant role in supporting effective collaborative learning, but does not determine its emergence. Lack of social interaction and negative social environments are the most significant barriers to realizing the potential benefits of CSCL.

In order to be able to fully realize the potential of CSCL, the motivational aspects of learning need to be understood (Dillenbourg et al., 2009). The following chapters first provide a discussion of the interplay between motivation and collaboration and finally link them to CSCL research.

2.4. Motivation and learning

According to Ryan & Deci (2000, p. 54), "[t]o be motivated means *to be moved* to do something". Motivation is the *why* behind our goals, decisions and actions. In order to understand why a student behaves (or doesn't behave for that matter) in a certain way, we need to analyze the motivational factors behind the behavior we are interested in. The motivation to be engaged and collaborative in an online environment is largely a matter of motivation, which makes is it a pivotal topic.
This chapter describes the tenants of the kind of motivation that drives productive learning and collaboration.

Generally it is common to think about whether or not someone is motivated, meaning their **level of motivation** (Ryan & Deci, 2000). A student who has a high level of motivation, is expected to be more active in their pursuit of a certain goal whereas a student who has a low level of motivation, is likely to be less active. In this mode of thinking, having as much motivation as possible is the optimal state for every student.

There are, however, also differences in the **type of motivation** which students have (Ryan & Deci, 2000). The qualitative differences in motivation substantially affect the way in which a student behaves and feels (Vallerand, Pelletier & Koestner, 2008).
One classic example of motivational types is the intrinsic-extrinsic differentiation. A student who is intrinsically motivated acts because of the sheer joy and enjoyment they get out of what they are doing. On the other hand, an extrinsically motivated student acts because of incentives or rewards outside themselves, such as getting a grade, finishing their degree or to avoid having to retake an exam. (Deci & Ryan, 1985a) Intrinsic and extrinsic motivation have been shown to explain a substantial amount of our behavior (Vallerand, 1997) although more recent studies have regarded motivational types as a continuum of autonomy rather than a simple dichotomy (see next chapter).

More autonomous types of motivation (such as intrinsic motivation) have been shown to be a significant contributor to better academic performance (Grolnick, Ryan & Deci, 1991; Pintrich & De Groot, 1990; Gottfried, 1990; Lloyd & Barenblatt, 1984; Haywood & Burke, 1977), greater conceptual learning and retention (Benware & Deci, 1984), more enjoyment while learning and a lower likelihood of dropping out (Connell & Wellborn, 1990). Because of these positive effects, it is not only important to cultivate a high level of motivation but be mindful of what type of motivation we want to cultivate. Thus it is important to understand how educators, learning platforms and peers can support intrinsic motivation among learners. How this is achieved is described by the Self-Determination Theory.

2.4.1. Self-Determination Theory

The Self-Determination Theory ([SDT]; Deci & Ryan, 2000, 2008) posits that students (and people overall) aim to satisfy basic psychological needs, from which their autonomous motivation stems. If the needs are met by the surrounding social environment, they are likely to result in favorable outcomes such as better performance, persistence, well-being and creativity (Ryan & Deci, 2000).

SDT identifies the basic psychological needs as *autonomy*, *competence* and *relatedness* (Deci & Ryan, 2000).

Having *autonomy* is to behave in a way that one feels is voluntary and congruent with our own will (Deci & Ryan, 2012; Deci & Ryan, 1985a; Ryan & Connell, 1989 *in* Deci & Ryan, 2002), having *autonomy* is to behave in a way that one feels is voluntary and congruent with our own will; “being the perceived origin of our own behavior” (Ryan & Deci, 2012, p. 85). For students, this could mean having enough latitude to choose learning content and a way of working that they feel is valuable. When students do not have autonomy (meaning they are controlled), the quality of their work and their affective experience are likely to suffer, even when they mainly behave in the way that they are instructed (Deci & Ryan, 2012, p.86).

The basic human need for *competence*, in turn, is (Deci & Ryan, 2002, p. 7) a “felt sense of confidence and effectance in action”. Students have a need to feel

that they are capable when acting in their social environment. This is achieved, for example, through displaying one's knowledge, achievement and positive external enforcement (such as praise or a good grade).

Relatedness refers to a need for social belonging; connecting with, accepting and being accepted by others (Deci & Ryan, 2002). For a student, this means having trusting social relationships to peers or feeling as being a part of a community, even something as abstract as the scientific community. (See next chapter for further details.)

According to the SDT, humans are naturally self-motivated and driven by these needs but can lose their autonomous motivation depending on the social environment, with which they interact (Deci & Ryan, 2008). If students do not get their basic psychological needs met, it will "diminish motivation, impair the natural developmental process, and lead to alienation and poorer performance" (Deci, Vallerand, Pelletier & Ryan, 1991, p. 333).

In spite of these benefits, intrinsic motivation is not the only driver of behavior. Even though students' motivation may be diminished in an environment where they are (for example) controlled and don't feel competent, they can still be driven to complete a task due to external motivational factors. This type of motivation, termed *extrinsic motivation*, is what is present when students make an effort because of the consequences of those efforts (Deci & Ryan, 2008). Examples of extrinsically motivated actions are: to complete a task because it earns course credit or to be active in a group discussion to avoid punishment for not participating.

Although controlled (extrinsic) and autonomous (intrinsic) types of motivation are different, they are not independent of each other. Several dozen experiments during the 90's showed that, contrary to the claims of earlier motivational theories, environments that strengthen extrinsic motivation (through incentives for example) lessen students' intrinsic motivation (Deci & Ryan, 2008). Hence one can't assume that autonomously motivated students' state is unaffected by exter-

nal incentives. This is relevant for teaching online, because it means that constructing an environment driven by external incentives will diminish the students' internal drive to learn.

Although motivational types are often described as a dichotomy (either being intrinsic or extrinsic), the SDT considers motivational types a continuum (Ryan & Deci, 2000). Along this continuum are motivational types which vary in the degree to which they are self-determined, with intrinsic motivation at one end and amotivation at the other (see Figure 1).

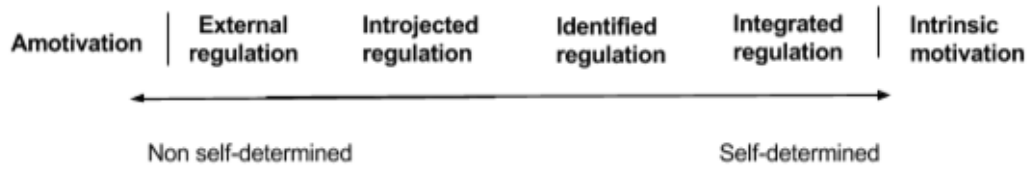


Figure 1. Self-determination continuum of motivational types. Adapted from Deci & Ryan, 2000, p.71

Amotivation signifies the "state of lacking intention to act" (Deci & Ryan, 2000, p. 72). This is a state where the learner is unclear about what the value of the activity is and is not motivated to act at all or acts in a passive manner (Deci & Ryan, 2002, p.17). Amotivation is separate from extrinsic and intrinsic motivation and arises when a student does not independently see the point of an activity and is not incentivized in a way that they would see it as a means to an end.

Extrinsic motivation, in turn, differs in the level to which it is self-determined (Deci & Ryan, 2000). External regulation refers to motivation that spurs from external rewards or expectations and is the least self-determined type of extrinsic motivation (Deci & Ryan, 2000,). External regulation is likely to manifest when a student does not themselves value an activity or feel it is important to them personally, but do it simply for the instrumental gains that they are expecting (Deci & Ryan, 2002), such as the points a task awards for their grade. This type of motivation is often experienced as alienating and controlling for the student and

can in some contexts predict students' likelihood to drop out of a course (Deci & Ryan, 2008).

Introjected regulation is a somewhat externally regulated type of motivation, where the individual's' ego is involved but the source of the motivation is not experienced as fully internal (Deci & Ryan, 2000). This type of motivation is likely to present when a student performs an activity in order to avoid shame and guilt, or wanting to display their ability in expectation of feeling proud (Deci et al., 1991). An example of external regulation is when a student is motivated to perform well on a quiz, because they know their result will be visible to other students, thus avoiding negative consequences for his/her ego.

Identified regulation is a fairly self-determined form of external motivation, where the individual consciously values the goals related to an activity and sees the activity as autonomous (Deci & Ryan, 2002). The students see this type of activity as their own and see that it corresponds with some aim that they hold internally but is not fully assimilated with other beliefs the students hold (Deci & Ryan, 2012).

Once an activity and its goals are fully integrated with the other values and beliefs held by the individual, the motivation is considered to be integrated regulation, which is the most self-determined form of external regulation (Deci & Ryan, 2012, p.89). Although this type of motivation is experienced as autonomous and assimilated with an individual's identity, it (and the other types of extrinsic motivations) are instrumental in nature. This means that the activity is not motivating in its own right, but a means to an end, which can be either internal or external.

Intrinsic motivation refers to the type of motivation, where an activity is performed for the sheer joy and enjoyment felt from doing it (Ryan & Deci, 2000). According to Ryan & Deci (2000) This type of motivation is present when students don't perform an activity because it will have some form of positive consequence but because it is driven by their innate curiosity. This type of motivation is most related to positive consequences in the form of individual well-being (Deci & Ryan, 2008) and learning results (Deci & Ryan, 1985a; Deci et al., 1991).

In summary, the Self-Determination Theory states that optimal motivation for learning and well-being is driven by the satisfaction of basic psychological needs of competence, relatedness and autonomy. When they are satisfied, students are likely to experience not only a high level of motivation but types of motivation that have favorable individual learning outcomes (Deci & Ryan, 1985a). Intrinsic motivation and self-regulated forms of extrinsic motivation are to be pursued, because “extrinsic motivators /.../ are generally ineffective for sustaining much excitement and passion for learning over the long haul” (Ryan & Powelson, 1991, p.50).

In an online course, it is then not only important to incentivize students but to create an environment that doesn’t thwart the drive on intrinsically motivated students and facilitates spawning that type of motivation. Compliance and a degree of knowledge can be achieved by external motivators but the real potential for pleasant and effective learning lies in harnessing students’ intrinsic motivation.

2.4.2. Situational motivation

Previous research has identified that motivation happens on several different levels of generality (Vallerand, 1997; Guay, Vallerand & Blanchard, 2000). Motivation is not determined by only individual disposition, the context in which it happens or what the specific situation is. It is determined by an interplay of all these levels.

Vallerand (1997) summarizes the levels of motivation as the global, contextual and situational level. The levels have their own affecting factors but the same mediators defined by self-determination theory apply on all levels; relatedness, competence and autonomy (Vallerand, 1997).

In research, these levels of motivation are most often analyzed separately and using different measures because a student’s motivation to learn can only be truly understood as a whole constituted by all these levels. This chapter describes how these levels of motivation are related but focuses on the situational level which is most consequential for the present study.

The global level of motivation refers to the individual personality traits related to his or her general motivational orientation (Vallerand, 1997). This means that

some students will have a different type of motivational predisposition at the outset, when for example starting a course. This global level of motivation affects the contextual level of motivation and can be affected by it in return (Vallerand, 1997). A student's previous experiences affect how motivated they will be during a course and their experience during the course may affect their motivation for future courses. There are several measures for global orientations, such as the General Causality Orientations Scale (Deci & Ryan, 1985b).

The contextual level of motivation refers life-domain specific factors of motivation (Vallerand, 1997). This means that an individual can have clear differences in how they are motivated in for example school and hobbies and that different contextual factors will affect their motivation in these domains. If, say, a student feels he has been coerced to complete an academic degree his motivation will be different than in a completely voluntary free-time activity. Interpersonal relationships, such as a student's friendships to other students, are considered a contextual factor (Vallerand, 1997). Several contextual measures of motivation exist. One example in the educational context is the Academic Motivation Scale (Vallerand et al., 1992), that measures the full spectrum of different types of motivation defined by the self-determination theory.

The situational level of motivation is, in turn, the motivation that an individual experiences as they are engaging in an activity (Guay et al., 2000). Situational motivation is what a student feels as they are learning and making decisions *in situ* (Vallerand, 1997). This level of motivation is paramount for students, because it has a substantial effect on the overall experience of learning (Csikzentmihalyi & LeFevre, 1989). It is not just a fleeting emotion but affects contextual motivation (Vallerand, 1997), has been shown to carry over to similar future experiences (Guay et al., 2000) and as being related to vitality and positive emotions (Sheldon, Ryan & Reis, 1996).

A student's situational motivation is affected by both contextual factors and cognitive factors related to the immediate environment (Hickey, 1997). The contextual factors that affect situational motivation include competition (Reeve & Deci, 1996), deadlines (Amabile, Dejong & Lepper, 1976), rewards (Lepper, Greene &

Nisbett, 1973), control imposed on the student (Koestner, Ryan, Bernieri & Holt, 1984) and the social relationships that they experience (Blumenfeld et al., 2006). Thus situational motivation among students can be affected by the way in which a learning situation and a course is designed. For a discussion of the motivational effects of social relationships, see the next chapter.
Immediate cognitive factors that affect situational motivation include the experience of challenge, capability and interest (Csikzentmihalyi & LeFevre, 1989; Nakamura & Csikzentmihalyi, 2014). So when a student feels the task at hand is sufficiently difficult, they feel skilled enough to complete it and they perceive it as relevant for them, they are more likely to be more situationally motivated.

Because the individual's global motivation affects the contextual motivation, which in turn affects the situational motivation, the situational motivation can be considered to serve as an output state of all the other factors affecting an individual's motivation. Although this may seem to be a leap in reasoning, Guay et al. (2000, p.176) states that "situational (or state) motivation, as measured at a given point in time, provides a useful understanding of a person's current (or state) self-regulatory processes".

Although several measures of situational motivation exists, only the Situational Motivation Scale (Guay et al., 2000) measures the different types of motivation described by the Self-Determination Theory (see chapter 2.4.3.) and has been extensively validated in a higher education context.

2.4.3. Motivation and collaborative learning

As briefly covered in the previous chapter, the social environment in which an individual is embedded has a strong effect on the type and level of motivation they are experiencing (see Deci & Ryan, 2012 for an overview). The motivation of individuals is affected indirectly by their satisfaction (or dissatisfaction) of the basic psychological needs of autonomy, relatedness and competence (Deci & Ryan, 2000). Although relatedness is considered a basic psychological need, the SDT theory does not cover which factors hinder an individual's motivation to actually collaborate and behave socially in a learning situation. It has, however,

been consistently shown that a lack of satisfaction of the need for relatedness impairs learners' overall motivation (Ryan & Deci, 2000).
This chapter describes how motivation is generally affected by collaboration and vice versa, which is a key topic in this study.

According to Järvelä, Volet & Järvenoja (2010), students' motivation in collaborative tasks can be hindered by some social factors that arise when interacting with their peers. Among university students these can be incompatibilities of personality, expectations or ways of working. Especially cultural differences and norms can sometimes hinder the collective problem solving and learning process, especially if those norms do not encourage informal collaboration (Järvelä et al., 2010). The need for relatedness is not satisfied when the collaboration is experienced as negative, because it doesn't create a feeling of connectedness which is the core of the psychological need for relatedness (Deci & Ryan, 2000).

Blumenfeld et al. (2006) summarize that students' needs for relatedness are met when they have pleasant interactions and collaboration with their fellow students and/or teachers.

Collaboration also has indirect motivational effects for individual learners. Student motivation is increased by students being driven to discuss and analyze the opinions of other students when collaborating, due to it producing cognitive engagement (Yackel, Cobb & Wood, 1991). Also, studies in a middle-school context indicated that student motivation was not only sustained by peer collaboration but served as a trigger of engagement for students previously uninterested in the subject (Holbrook & Kolodner, 2000). This means that previously disengaged students may be "roped in" to subject matter and learning through social interaction with their peers.
In summary, the positive motivational effects of collaboration among students is significant, persistent and has positive indirect effects, when occurring in a successful manner.

The positive correlation between collaboration and motivation has been especially well documented in a face-to-face learning context with small groups on

several different levels of education (Blumenfeld et al., 2006). Research has, however, shown that the need for relatedness can also be satisfied through collaboration in a larger community of learners (Blumenfeld et al., 2006). An experience of membership in the community can increase student engagement and result in internalization of values and practices held by the collective. This means that it is through positive engagement with the learning community that positive knowledge practices can be spread from the community to new participants.

The motivational risk in collaboration and other types of social interaction is, as stated earlier, in negative social phenomena such as social loafing and conflict created by differences in goals and expectations among students. Some studies have shown that the risks can be mitigated by structuring and directing the collaboration (Blumenfeld et al., 2006). There is, however, a likelihood that this would decrease a sense of autonomy among students, of course depending on how the direction is communicated and implemented. Overall it is evident that the risks of "allowing" collaboration in a group of learners are heavily outweighed by the benefits shown by decades of research independent of context and quality of implementation. It is, however, evident that there are situations where collaboration is not practically possible or collaboration is misaligned with the learning goals that have been set. In an online learning context it seems, however, that the opportunities of collaborative learning have been largely untapped by mainstream implementations.

2.5. Motivation and collaborative learning in an online context

As described in previous chapters, a student's motivation in a learning situation will be optimal if the environment supports their basic psychological needs for competence, autonomy and relatedness. Collaboration with other learners has been found to support these needs in a classroom context, and thus elicit the type of motivation that is "conducive to more adaptive cognitive, affective and behavioural outcomes" (Vallerand et al., 2008, p.257).

Although social processes that occur online often seem similar to those in a face-to-face situation, teaching and learning in an online context is a very different experience. The methods and formats that work in an traditional classroom cause

different outcomes online and waste collaborative opportunities afforded by technological tools (Maor, 2003). In studies that compared collaborative learning online and in person, they discovered differences in motivation (Järvelä, Järvenoja & Veermans, 2008) and group dynamics (Rienties et al., 2008). In pedagogical research, computer-supported collaborative learning has for the last decades been considered its own field. Although parallels are drawn to face-to-face learning and the basic psychological needs are the same, the motivational factors and learning processes can't be assumed to be equivalent. This chapter draws a synthesized description of the themes described in previous chapters (collaborative learning, motivation and online learning) in order to outline what is currently known about the motivation to collaborate in online courses. Lessons are drawn from studies in organizational learning as well as higher education.

2.5.1. Collaborative learning in organizations

In some of the biggest non-governmental organizations and companies in the world, online learning communities have often been used for sharing best practices and fostering different types of professional development. The learning processes in these communities take the form of online discussion boards, live chats, video communication, group discussions, sharing materials and solving problems together (Ardichvili, 2008). These are the same ways of learning online that are used in higher education contexts. In the organizational learning context, motivational barriers and enablers have been studied more extensively than in higher education in order to better understand how to encourage participation for the benefit of organizations.

Ardichvili (2008) listed the motivational categories of interacting in an organizational online learning community as personal benefits, community-related motivators and normative considerations.

Possible benefits for the individual are showing their own skill to other learners (Ardichvili et al., 2003), advancing their own career or pursuing status in the community (Scarbrough, 2003). Additionally, Wasko and Faraj (2000) found participation to be partially motivated by information gains, such as finding an answer to a question individuals had themselves and only interacting with other members

when they needed something. In a later study they, however, found that sharing knowledge was not accompanied by an expectation for immediate reciprocity (Wasko & Faraj, 2005).

Wasko and Faraj (2000, 2005) found that the communal aspect of participation motivated people to share knowledge. In a study they carried out, 41.9% of participants in an organizational virtual learning community reported being motivated by interacting with the community itself (Wasko & Faraj, 2000, pp.164-5). It was the most frequently mentioned motivational aspect, whereas tangible personal gain (such as informational gain or career benefit) was only mentioned in 21.5% of cases (Wasko & Faraj, 2000, p.164).
Chiu, Hsu & Wang (2006) and Ardichvili (2008) also mentioned communal aspects as a big motivator for participation. They found that learners wanted to establish reciprocity, create ties with others and increase their own belongingness in the community by sharing knowledge (Ardichvili, 2008; also Scarbrough, 2003). Chiu et al. (2006) also stated, that identification with the community and its goals was a motivational factor.
Based on these results, the need for relatedness is a vital motivational factor for engaging learners in the social interaction of an online learning community, at least in the context of organizational learning.

Normative motivators for interacting with a group refer to social pressures that affect a learner. These include following the example of leaders (Scarbrough, 2003), conforming to the behavior of others (Wasko & Faraj, 2000) and being affected by organizational culture (Ardichivili, 2008).

As espoused by the self-determination theory (see chapter 2.4.1), attention should be payed to the factors that hinder an individual's psychological needs from being realized, thereby thwarting their motivation.
In an organizational context, several barriers to the motivation of participating in the social interaction of an online learning community have been identified. Wasko & Faraj (2000) found the most significant barrier to be related to negative social phenomena, such as personality differences within the community and differences in expectations. Other social factors that have been found to affect the

motivation to participate negatively are fear of criticism, insecurity and conceptions of what is the normative way of sharing knowledge in the community (Ardichvili et al., 2003; Ardichvili, Maurer, Wentling & Stuedemann, 2006). Extrinsic motivators, such as rewards or administrative pressure were found to be either detrimental to motivation or, in some cases, less effective motivators than the factors mentioned earlier (Osterloh & Frey, 2000).

The results of these studies were often conflicting in what they emphasized, indicating a complex and varying array of possible reasons for participating in collaborative learning in online communities. There seems, however, to be both extrinsic and intrinsic reasons for participating in the collaboration. Both individual benefits and communal motivations were consistently highlighted in the studies reviewed.

2.5.2. Collaborative learning in higher education

In a higher education context, most learners have been found to contribute very little to online discussions (Caspi, Gorsky & Chajut, 2003; Guzdial & Carroll, 2002). This may be detrimental to learning results, because researchers have espoused that computer-supported collaboration only provides a good environment for high-quality learning if there is active discourse and co-construction of knowledge (Beers, Boshuizen, Kirschner & Gijselaers, 2007; Schellens & Valcke, 2006; Paavola & Hakkarainen, 2009). A recent study also suggested, that inactivity in participating in discussion may also lead to higher dropout rates (Caspi et al., 2003).

Using collaborative technology for learning has been found to have both positive and negative effects on learner motivation and results.

Blumenfeld et al. (2006) suggested that online collaboration increases overall student motivation by increasing interest towards the learning process and creating cognitive engagement. A meta-analysis found that the amount of interaction was consistently positively related to both learning results and satisfaction with the learning process (Bernard et al., 2009). Similar results were found by Russo & Koesten (2005) who found a correlation between a central position in the social structure and positive learning outcomes. This increase in achievement

and motivation been attributed to the (a) increased autonomy and competence that comes with students progressing at their own pace and having more ownership of their own learning and (b) the relatedness to other learners that comes from communication (Blumenfeld et al., 2006; Giesbers, Rienties, Tempelaar & Gijslaers, 2013). Garrett, Thoms, Alrushiedat and Ryan (2009) also concluded, that the knowledge of other students seeing what one contributes increases motivation and persistence.

In addition, online communication has been found to be a place for less extroverted students to participate in the social interaction (Brush, Bargeron, Grudin, Borning & Gupta, 2002). Even just observing the communication of others has been suggested to increase learning by triggering the cognitive processes that are related to communication, such as forming your own opinion or analyzing what others have put forth (Guzdial & Carroll, 2002).
These results strongly suggest that the social presence of others in the online learning process improves learner motivation and is, at least indirectly through the motivational effects, related to improved learning results.

The negative effects of online collaboration on motivation and learning results are different, depending on the implementation. Blumenfeld et al., (2006) noted that using technological tools in interaction increases the complexity of the process. Using new tools requires students to learn new ways of working, which may decrease their motivation towards both the subject matter and the tool itself - depending on their experience. When encountering bugs in the tool or experiencing other trouble adopting it, it may change their will to participate in the learning process. Time and effort spent using the software itself may be subtracted from the time and effort spent engaging with the learning content itself (Blumenfeld et al., 2006).
Järvelä et al. (2008) also noted in their study of a university course, that when comparing groups working on the same task face-to-face and online, students working online had more performance-oriented goals than those working face-to-face. Student groups that worked face-to-face had slightly more learning-oriented goals. The authors suggest that difference was caused by differences in the co-regulation of motivation (which appeared to be more effective in the face-to-face

setting) but the results were not conclusive (Järvelä et al., 2008). Although the results of research on computer-supported collaborative learning has often been positive, it is worth noting that technology is only a tool for better learning and may or may not have the positive effects that are advertised depending on situational factors and the quality of implementation. These tools can be, but necessarily aren't, an effective means to the end of more effective and pleasant learning. As Hakkarainen (2009, p. 214) summarized, "technology enhances learning through transformed social practices".

What are then the factors that affect an individual's motivation to participate and achieve fruitful social learning mediated by technology? Hartnett, George & Dron (2011) suggested that motivation to learn online should take into account individual differences, the learning context and situational aspects.

Rienties, Tempelaar, Giesbers, Segers & Gijselaers (2008) found that there was a correlation between motivational types and social participation in online discourse. Intrinsically motivated students (measured on the contextual level) were found to be the most avid and central contributors to the discussion. This effect was shown to be progressively increasing, due to them being engaged with by other students due to their own initiative thus receiving a sort of positive feedback loop for their social engagement. Rienties et al., (2008) suggested, that the opposite may be true for extrinsically motivated students who don't take the initiative to participate and thus are not part of this positive spiral of feedback. This effect is increased by their finding, that students who are intrinsically motivated are more likely to engage with students with the same motivational profile and also more likely to be engaged with by extrinsically motivated students (Rienties et al., 2008).

These findings were, however, not supported by studies made by Giesbers, Rienties & Gijselaers (2013;2014) later on. They found no significant correlation between the amount of online social interaction carried out by students and their motivational profiles (Giesbers et al., 2013; Giesbers et al., 2014).

Although the link between individual factors and motivation to collaborate is not yet clear, an interplay between the learning context, individual factors and the motivation to collaborate has been document in some studies.

Järvelä, Hurme & Järvenoja (2011) suggested that students need heavy scaffolding from their learning context in order to be able to produce fruitful collaboration. Otherwise, the collaborative efforts may be unsupportive of learning.

Rienties et al., (2012), however, found that the success of scaffolding in the virtual learning environment depended on the motivational profile of the students. While control-oriented (i.e. extrinsically motivated) students were found to benefit from the scaffolding and it encouraged them to participate, autonomously motivated students were "turned off" by it and decreased their contribution. Due to the cumulative effects mentioned above, this decreased the overall amount of communication. (Rienties et al., 2012). They suggested that autonomy support was the key to increase student engagement (Rienties et al., 2012). Interestingly, scaffolding has been found to be an effective strategy in blended and purely face-to-face learning (Rienties et al., 2012) which further strengthens the conception of online learning being a motivationally different context.

Other factors in the learning context that affect learners motivation to collaborate have also been found.

The learning task and how it is communicated affect how much learners collaborate (So, 2009; Hartnett et al., 2011; Blumenfeld et al., 2006). If students perceive that the learning task requires them to collaborate (establishes interdependence; Blumenfeld et al., 2006), attractive means of communication are available (So, 2009) and they understand how it supports their learning (Hartnett et al., 2011), students are likely to collaborate.

Järvelä et al., (2011) also emphasized, that the norms present in the learning context need to be favorable in order for fruitful collaboration to take place. Students are more likely to collaborate, if they find that it is acceptable to make mistakes, share ideas and they can trust other people present in the learning situation (Järvelä et al., 2011; also Maor, 2003).

The tools themselves also affect learner's motivation to collaborate. So (2009) found the perceived affordances and ease of use to affect the willingness of

groups to use the tools. Lee, Cheung & Chen (2005) found, more specifically, that the perceived enjoyment of using a technological tool affected the intention of further use it but that perceived usefulness or ease of use did not.

2.5.3. Fostering collaboration in an online learning context

Based on the results of previous studies (see above), fruitful collaboration can increase learner motivation significantly and contribute to learning results. It has, however, been difficult to foster. Not much prescriptive academic literature relevant to the modern online learning context seems to exist, but some instructions are available.

Paavola & Hakkarainen (2009) listed design principles, that were found to support trialogical knowledge practices in computer-supported collaborative learning:

- Organize activities around shared objects.
- Supporting interactions between personal and social levels
- Eliciting individual and collective agency
- Fostering long-term processes of knowledge advancement
- Emphasizing development through transformation and reflection between various forms of knowledge and practices
- Cross fertilization of various knowledge practices across communities and institutions
- Providing flexible tool mediation

Pilkington & Walker (2003) also suggested giving discussional roles to students in group assignments, such as “devil’s advocate” or “organizer”. Other interventions in the discussions among learners by the course staff have also been recommended (Maor, 2003).

Maor (2003) concluded that fostering collaborative learning requires a shift in the role of the teacher from simply providing knowledge to facilitating favorable learning processes of peer-learning, thus increasing feelings of autonomy and ownership among students. Promoting both purely social and subject matter-related communication was also recommended as a means to spur commitment (Maor, 2003).

Blumenfeld et al. (2006) and Maor (2003) also emphasized the need for commitment from course staff and other personnel to support the collaborative learning and the use of new tools as a critical success factor.

There is a clear appeal in controlling the collaborative learning process in order to avoid social loafing and manage learning results in the spirit of constructive alignment (Biggs, 1996), but facilitating learners' achievement of the basic psychological needs of autonomy, competence and relatedness have been established as the optimal way to facilitate learner motivation for collaboration in an online context (Dillenbourg, 2002).

In summary, computer-supported collaborative learning has many clear benefits, including improved learning results and positive affect, when successful. One key factor that drives to success of CSCL is the quality and amount of collaboration. It is common that collaboration does not happen in online environments, which causes the learning results and learner satisfaction to decline and seems to increase the probability of students dropping out. Scaffolding may increase the likelihood of knowledge building collaboration, but risks decreasing a feeling of autonomy among students.
Other factors that affect the students' willingness to collaborate are how the task is communicated, how attractive the available tools are perceived as and to what extent student perceive that the collaboration will aid their own learning. Additionally, the perceived atmosphere needs to be trusting, allowing of mistakes and encourage participation.
Results from research on organizations suggest that extrinsic motivators may be detrimental to the learner's motivation to participate, which is often driven by communal aspects and not individual benefit in the long run. The main barrier to successful collaboration appears to be social phenomena, such as loafing and personality conflicts.

3. Aim and research questions

The aim of this study is to analyze learner's motivation to collaborate in an online course. This is achieved through sampling the situational experience in collaborative actions and describing the social context of the learning on a community level.

The data collection is carried out in a higher education context, during an online course at a university in Finland. The course contained individual as well as group assignments carried out in a learner-driven manner on a social online learning platform.

Specific research questions are:

1. How does a student experience their motivation to collaborate in an online course?
    a. What is the situationally perceived source of motivation (intrinsic/extrinsic)?
    b. Is the motivation related to deadlines?
    c. Is the motivation related to progression in the course?
2. What patterns of social interaction emerge during an online course?
    a. What is the structure of the learning community that emerged during the course?
    b. What is the level of cohesion in the emergent community?
    c. How homogeneous is the level of participation in social interactions?
3. To what extent are the situational experiences related to the patterns of interaction?
    a. Is situational motivation related to the level of participation in social interactions?
    b. Is situational motivation related to the student's social position in the learning community?

4. Method

This study studies motivation to collaborate *in situ* through the method of context-sensitive contextual momentary assessment (CS-EMA; Csikzentmihalyi, 2013; Intille, 2007) and its community level context through social network analysis (SNA; Palonen & Hakkarainen, 2000; Wasserman & Faust, 1994; Scott, 2007).

In order to understand the situational and context-sensitive nature of motivation and the learning process, they need to be researched in their authentic context (Järvelä et al., 2008). In this study, this is achieved through context-sensitive questionnaires programmed into the learning platform, which trigger at times of collaboration. They sample the situational motivation of students at the time of the action, in order to best capture the experience.

The level of participation in collaborative learning is related to (if not a consequence of) motivation to collaborate (Wenger et al., 2002). In addition, social engagement is a predictor of drop out (Wen et al., 2014; Sinha et al., 2014), motivation (Ryan & Deci, 2000) and the quality of learning in an online context (Blumenfeld et al., 2006). Due to this, the level of social engagement is an important aspect of research, which is in this study measured by analyzing the participation in chat messaging and contextual discussions through social network analysis [SNA].

In this study, collaborative behavior was operationalized as sharing content with other students, asking questions and responding to a question or comment made by a peer. Chat messaging can be indicative of collaborative behavior but necessarily isn't. Due to this distinction, chat messages are not crudely assumed to be collaboration but a form of social engagement.

Other methods of research that were considered (content analysis of interactions, sentiment analysis of chat messages, participant observation, semi-structured interviews, retrospective questionnaires, trait questionnaires) would have been less potent in answering the research questions, although they would have provided a stronger qualitative perspective on the students' motivation. These methods

are, however, very common in CSCL research and the information to be gained from using them is more likely to be saturated by earlier studies.

4.1. Participants

The participants of the study were economics students at a university in Finland (*N*=179), enrolled in an online course on responsible business. The participants were 19-61 years of age (*M* =26.1, *SD* =4.6) in different phases of their degrees. The participants were mostly Finnish (79%) with a minority of students (22%) from different countries all over the world. There were roughly an equal amount of reported female and male students (47% and 46% respectively) while some students chose not to disclose their gender (7%).

Participants gained access to a short training video that contained information on how to use the learning platform and what its main principles are. In the video and in two separate messages, participants were informed of the research study being carried out during the course and received instructions for how to opt out at any time if they wished to do so.

4.2. Course structure

The data collection in this study was carried out during a course at a university in Finland. The course could be completed either remotely or as blended learning, meaning attending both face-to-face lectures and meetings and using the online learning platform. In either way, the majority of learning activities happened on-line.

The course was split into five parts, which were completed consecutively with timed start and end dates. The course grade was formed based on how many parts of the course the student attended and passed. The course included online individual and group assignments, with few optional face-to-face lectures and group meetings.

	Learning tasks	Duration
Part 1	Individual assignment based on given materials, video commenting assignment	1 week
Part 2	Peer teaching videos in groups, individual report	2 weeks
Part 3	Co-writing blog in small groups, shared with all course participants	2 weeks
Part 4	Online exam completed individually	1 week
Part 5	Co-writing report in groups based on a real-world organization case	3 weeks

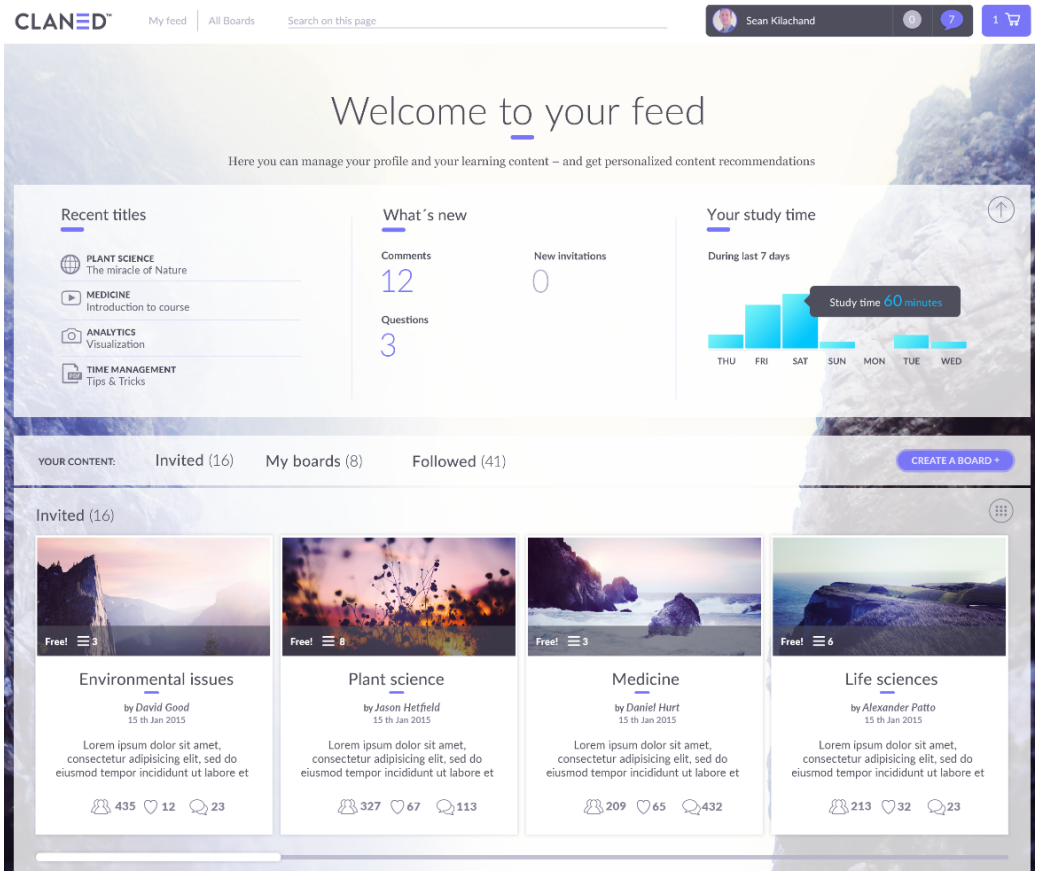
Table 1. Course structure

Collaboration was not explicitly required during the course, but at least some interaction was built into the group assignments. The groups in those assignments were formed so that students with as many different majors as possible were in each group of 4-6 people. After being given a description of the task, students were free to self-organize their work. Course staff occasionally provided information about practicalities and subject matter, but a vast majority of the learning process in the group was directed by the students themselves.

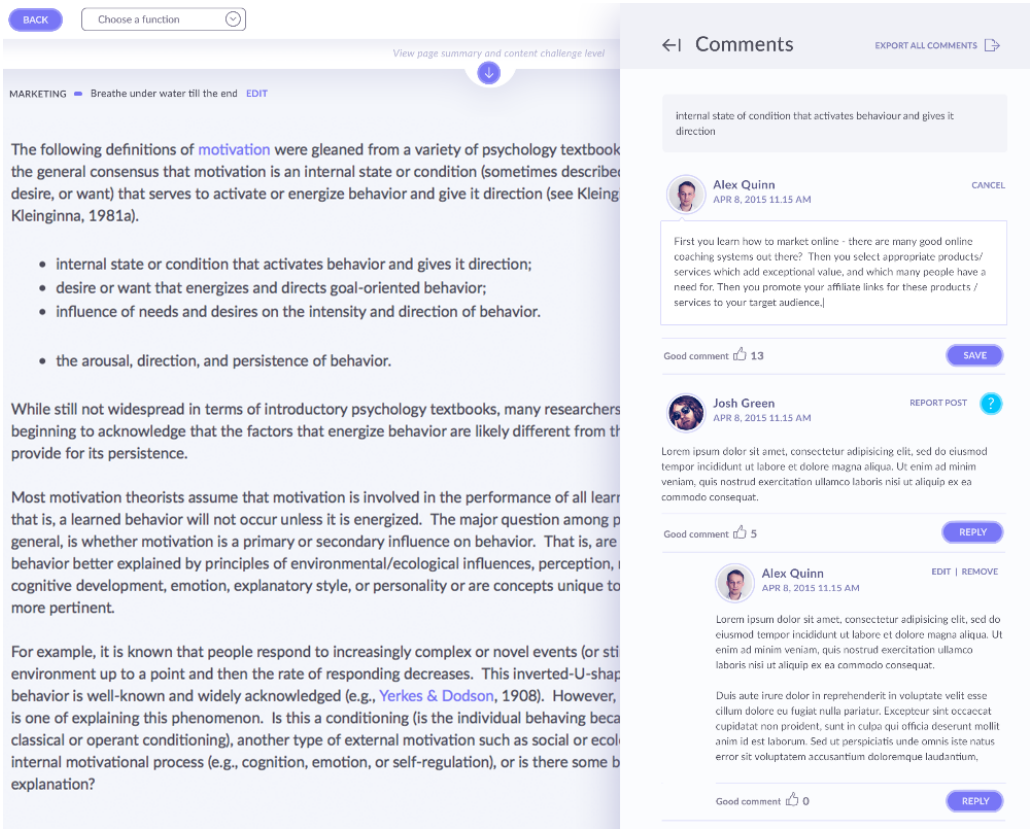
During the course, the students used an online learning platform for nearly all activities related to the course, including reading documents, watching videos, collaborating, socializing and returning assignments. See the next chapter for a description of the learning platform.

4.3. The CLANED™ learning platform

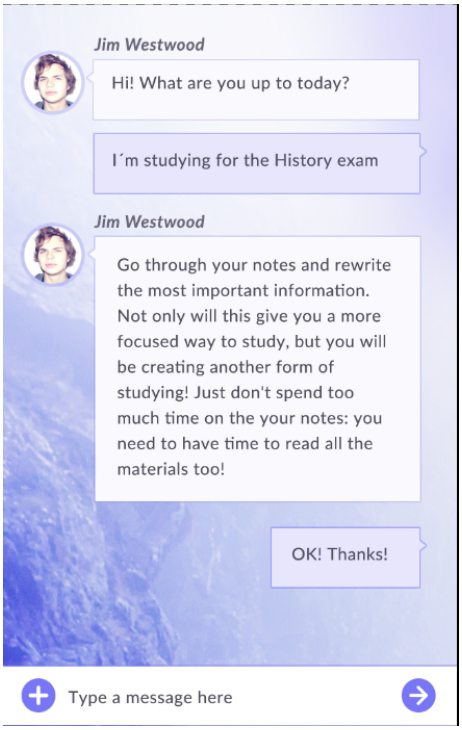
CLANED™ (http://app.claned.com) is a cloud-based social learning platform. It is used for education in several different levels and contexts, from primary schools to organizational training. It was created to facilitate collaborative learning while providing scientifically valid learning analytics.



In CLANED™, learners can share any type of learning materials, which are automatically made susceptible to contextual discussion through e.g. commenting in text, time-specific notes in videos and Q&A functionality. Students are encouraged to reply to questions and comments made by their peers, share materials and chat with each other, without requiring to go through an administrator or teacher.



CLANED™ is a cloud-based life-long learning platform created for the learner, hosting personal accounts that are accessible to the learner independent of a learning institution. Learners can add their own personal material to the platform and share them with any other user they choose, while having access to material shared to them by their learning institution or other users.



The platform provides analytics of interactions, behavior, challenge, competence and interest. Measures of flow (Csikszentmihalyi, 1996) and user behavior (such as time spent studying by students) are measured specifically to materials and are accessible to the teacher and students themselves in real-time, supporting students' self-reflection and teachers' course design. CLANED™ also provides analytics on

which topics students have found interesting or difficult automatically, based on semantic analysis of learning content that has been added. These analytics are intended to provide insights to the teachers which directly help in orchestrating and scaffolding the learning process in a blended learning or distance learning context.

The platform is designed to be fluent and open, allowing learners to create learning areas for themselves and their peers at any time and add their own material they have found or created on their own. Individual learning is also supported in the environment by providing functions for highlighting, in text or video notes, tools for focus and short-term goal setting etc.

4.4. Data collection and analysis

The data collection and analysis in this study consists of two parts, the context-sensitive ecological momentary assessment [CS-EMA] and the social network analysis.
These were carried in a 9-week period, during which the CS-EMA was triggered by collaborative behavior and user interactions were logged for the SNA analysis. This section describes how the data was collected and analyzed.

In the last decades, the behavioral sciences have shown an increasing interest in studying experiences at scale in real time (Csikszentmihalyi, 2013). The benefit of these methods, collectively called experience sampling methods, is that they reduce memory bias by not being as prone to reconstructive memory processes and study phenomenons *in situ* as they occur in life (Scollon, Prieto & Diener, 2003). The memory bias exists due to the fact that when we recall events, we do not “play back” an objective recording but recreate an image from subjective pieces of information in our memory (Barrett & Barrett, 2001). Experience sampling methods are thus especially suited for studying subjective experience that is tied to a specific moment (Csikzentmihalyi, 2013), such as experiences related to social interaction or physical feelings. Research has indicated that real-time experience measures consistently outperform traditional retrospective methods (such

as questionnaires and interviews) in accuracy and validity when studying subjective experience (Scollon et al., 2003).

The experience sampling methods are not, however, a “golden standard” for any type of research question in the behavioral science. More recent inspections have indicated that they are not as well suited for studying beliefs held by individuals or predicting future behavior as retrospective methods (Csikzentmihalyi, 2013; Wirtz et al., 2003). While real-time reports are more accurate accounts of situational experience, we form our perceptions and make decisions based on biased memories.

These contextually sensitive survey methods, dubbed context-sensitive ecological momentary assessments ([CS-EMA]), are suited for studying unpredictably occurring and relatively rare experiences and especially social interactions (Csikzentmihalyi, 2013; Intille, 2007). Because the questionnaire was presented to the students immediately and automatically after the collaborative behavior, the effect of memory bias is lower and there is a smaller risk of forgetting to report. The automatic timestamps and usage logs created by the platform also provided contextual information and eliminate the risk of incorrect reporting (such as wrong time and date information), which are common problems in pencil-and-paper assessments (Csikzentmihalyi, 2013).

Event-contingent assessment has been used somewhat extensively in primary school (see e.g. Boekaerts, 2002) and higher education settings (Guay et al., 2000) to measure situational motivation with pen-and-paper questionnaires with high validity. In more recent studies, electronic context-sensitive measures have also occurred but are still not commonplace (Csikzentmihalyi, 2013). This is likely to change as technology-supported learning becomes more pervasive, due to the utility of automation.

Context-Sensitive Ecological Momentary Assessment

In this study, an experience sampling method was employed in order to capture individuals' experiences of the source of their motivation to collaborate (research question 1a). The sampling was carried out as event-contingent experience sampling triggered by specific behaviors carried out on the learning platform. In practice, students who behaved collaboratively were automatically asked to fill out the Situational Motivation Scale survey when they behaved collaboratively (details below).

The behaviors that triggered the questionnaire were:

1. Sharing content with other students
2. Asking a question visible to other students
3. Responding to a question or comment posted by a peer

The participants were prompted to answer the the Situational Motivation Scale (SIMS; Guay et al., 2000), measuring the perceived source of their motivation. The SIMS-questionnaire operationalizes motivational types on the intrinsic-extrinsic continuum contained in the self-determination theory of motivation (see chapter 2.4.1 for a discussion). It contained 12 statements with answer options on a 7-point likert scale ranging from "does not correspond at all" to "corresponds exactly". The motivational source constructs that were measured in this study, were intrinsic motivation, identified regulation and external regulation. Amotivation, although a part of the full SIMS-questionnaire, was not measured because it is outside the scope of this study and would have expanded the questionnaire unnecessarily thus disrupting the learning process even more. See Appendix A for the abbreviated SIMS-questionnaire used in this study, as seen by a participant.

The questionnaire was triggered a total of 287 times in the situations described above and received 216 responses from 119 different students. The overall response rate was then 75,3%, which, according to Conner & Lehman (2013), is a high response rate and clearly sufficient. 245 of the questionnaires were triggered by students sharing material, 4 by asking a question and 38 by replying to a comment made by a peer. 19 of the entries were removed for having answered less

than 90% of the questions asked in the questionnaire, as suggested by McCabe, Mack & Fleeson (2013). In entries where less than 10% of values were missing (i.e. one response) they were replaced by the average of the values in the other items related to the same measure of motivation. After data cleaning, a total of 219 complete entries were used in the analysis (N = 219).
In order to be able to analyze different types of collaborative events separately, a minimum of 70 questionnaire responses per event would be required (Csikzentmihalyi, 2013). Due to the insufficient amount of measurements from questions and comment replies, all collaborative events are analyzed as one category.

In the analysis, all three motivational measures were found to be non-normally distributed in the Kolmogorov-Smirnov test of normality ($p < .001$), and are thus analyzed with nonparametric measures. Group differences were analyzed with the Mann-Whitney U test and correlation with Spearman's rho.

Social Network Analysis (SNA)
Social Network Analysis [SNA] (Wasserman & Faust, 1994; Scott, 2007) is a collection of methods that analyze social structure in the form of graphs. They have long been used in fields such as the social sciences, sociology, communication studies, computer networks and economics for analyzing both individual and group level characteristics (Aviv, Erlich, Ravid & Geva, 2003). In contrast to other statistical methods, SNA methods focus on the relationships *between* people rather than their attributes or experience (Palonen & Hakkarainen, 2000).
Social network graphs, which are the target of analysis in the SNA methods, are formed based on information of relationships (*edges*) between the actors (*nodes*) (Scott, 2007). In learning research the nodes usually signify learners and the edges are communicative relationships between them. What those relationships entail depend on the study, ranging from email sent between the learners to friendships indicated in a questionnaire to many other types of interaction.

Since Garton, Haythornth and Wellmann (1997) suggested analyzing online networks through SNA, there have been a surge of studies using this method to analyze social structure in online learning. These methods have been found to

help researchers understand the sociocognitive processes of collaborative learning and what how they affect individual students (Palonen & Hakkarainen, 2000).

When analyzing groups or communities of learners as a whole, SNA methods provide measures for the cohesion, density, homogeneity of interactive behavior, reciprocity and network density (Wasserman & Faust, 1994). These measures give a comparable account of the learning collective as a whole, providing information on the existence of sub-groups, differences in how much students participated in social interaction etc. These measures can be considered complementary to research methods focusing on the individual.

On the level of the individual, SNA methods analyze, for example, the learner's social position in the group (centrality) and the amount of communication they have partaken in (degree).

In the present study, learner behavior on the learning platform was logged automatically based on their activity in the system. The interaction was modeled on the community level as a directed and weighted one-mode sociogram, meaning that it is a picture of which learners interacted with whom - and how much. This provides a richer image of the collaborative practices than simple true-false undirected structures (Scott, 2007, p. 47). It is possible for example, that a student receives many chat messages but rarely replies. It is also likely that the level of reciprocity (amount of back-and-forth communication) is very different even among those that do collaborate. Some may be in contact daily while other encounters are brief one-time instances. These factors, direction and strength of a tie, are accounted for in the sociogram.

The data used in the sociograms are based on the actual actions carried out on the learning platform. In practice, log data mined from the platform provided an image of the network structure based on chatting in groups. All these pieces of information were used to compute the edge weights (which is the strength of the relation between two people; Scott, 2007).

The SNA data was analyzed in order to gain information about the prominence of each individual in that group, measured as *centrality* and *betweenness centrality* (Wasserman & Faust, 1994). The centrality measure provided an analysis of the

structural centers of the group whereas the betweenness measure gives information on the extent to which the individual links subgroups in the social network to each other (Scott, 2007).
The structure of the network was also analyzed for its level of modularity (Wasserman & Faust, 1994), clustering (Opsahl & Panzarasa, 2009) and network density (Wasserman & Faust, 1994).
Individual students were analyzed using Freeman's degree, centrality and betweenness centrality (see above; Scott, 2007). These are measures of the level of participation in the social interaction and the student's social position in the group.

Altogether 2802 chat messages were analyzed (N = 2802). In the data cleaning, 34 messages were removed as duplicates and 1 message was removed because it was empty.

In summary, network analysis provided an analysis on the collective level of the collaborative learning and information on students' participation and social position. The analysis was carried out in the SNA software Gephi, version 0.9.1 (https://gephi.org/).

4.5. Ethical aspects

In all research with human participants, it is paramount to guarantee that high standards of privacy, confidentiality and informed consent are followed (Smith, 2003).
In this study, these standards were guaranteed by several explicit measures.
Data was collected from the start and throughout in a format, where participants were anonymized and only identified by a number id. The data was stored securely behind password protection and access was restricted to the author of this study.
From the outset of the study, participants were informed about the study being carried out and participation was strictly voluntary and not incentivized. They were informed about the purpose of the research, the relevant procedures, their rights and who to contact in case they had questions or wanted to withdraw from the

study. These measures are recommended by the APA Ethics Code (American Psychological Association, 2010).

In addition to these considerations that are present in most research settings, some other aspects need to be taken into account when carrying out experience sampling. In this study, students were prompted to answer a questionnaire when they were studying. This constitutes an interruption in their learning process and may disturb them to some extent. In order to minimize the strain to participants, the original 16-item questionnaire was shortened to 12-items by leaving out one of the measures. Due to collaborative acts only happening now and then and it taking only roughly 3 minutes to complete the questionnaire, the disturbance to their studying was minimal.

When studying the interactions carried out by students, the content was not analyzed which limits the invasion of privacy. The interaction data was anonymized at the outset and all the data that wasn't relevant to this study was removed from the dataset.

Overall, it is important to be even more mindful of ethical aspects of research when collecting data on an extensive scale in real-time. Compared to traditional quantitative methods, the risks of privacy violations are more extensive and as the sampling and analysis becomes more complex there is a risk of losing track of how it relates to the individual's rights and other aspects of research ethics.

5. Results

This chapter provides an account of the results of the study. The results are first presented in segments that correspond to the research questions and then summarized in chapter X.X. Readers only interested in a quick overview, can skip directly to the summary and then read the discussion in chapter 6.

5.1 Situational motivation to collaborate

On average, students were found to experience more external than internal forms of situational motivation to collaborate during the online course. As you can see from the box plot below (Figure 2), there was a high level of variation in what level of each motivational type the students reported on average.

All three measures (intrinsic motivation [IM], identified regulation [IR], external regulation [ER]) were found to have a very high degree of internal consistency based on the Cronbach's alpha measure (IM α = .93; IR α = .90; ER α = .89) where values over .70 are generally considered acceptable (Nunnally, 1978).

None of the three motivational constructs were found to be normally distributed in the Kolmogorov-Smirnov test of normality (p<.001).

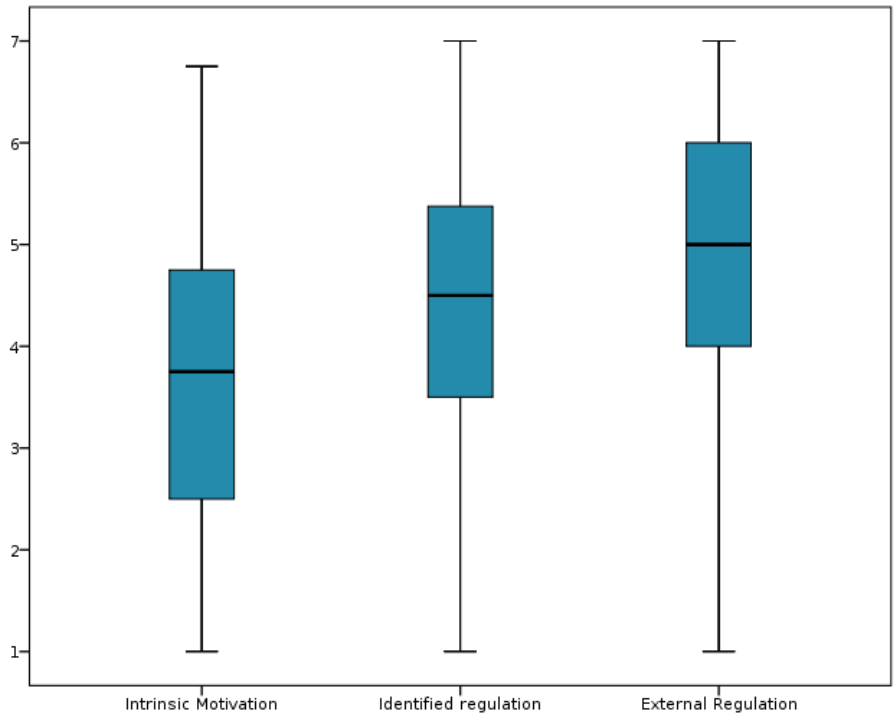


Figure 2 Average by motivational type

Students' reported level of intrinsic motivation, was on average moderate with a fairly high level of deviation among reports (*M* =3.60, *SD* =1.52).

As seen in figure 3, there appeared to be a cluster of occurrences where intrinsic motivation was experienced as non-existent or very low. In 41 of the 204 reports (20,1%), the average rating of intrinsic motivation was less than or equal to 2. Otherwise the reports appeared to be somewhat normally distributed.

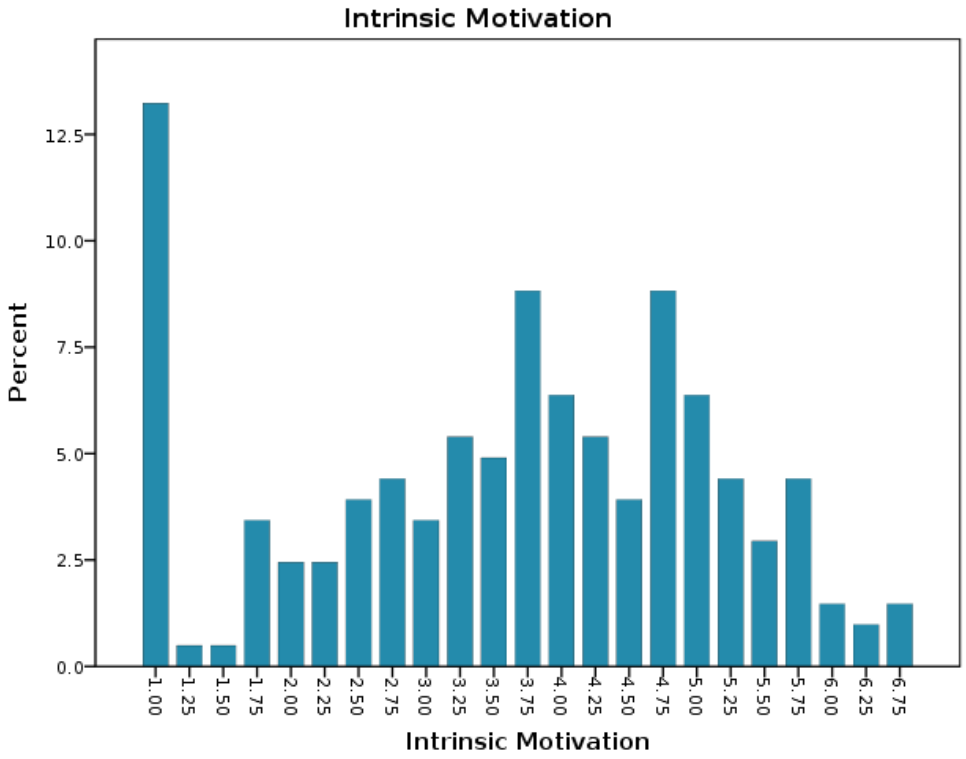


Figure 3. Frequency distribution of intrinsic motivation

On average, students reported a moderately high level of identified regulation (*M* =4.20) with a high level of deviation among reports (*SD* = 1.60). As can be seen in figure 4, there appeared to be a cluster of occurrences where the level of identified regulation was experienced as non-existent or very low. In 28 of the 204 reports (13,7%), the average rating of identified regulation was less than or equal to 2. This is, however, a clearly smaller cluster than that in the intrinsic motivation. Otherwise the reports appeared to be somewhat normally distributed.

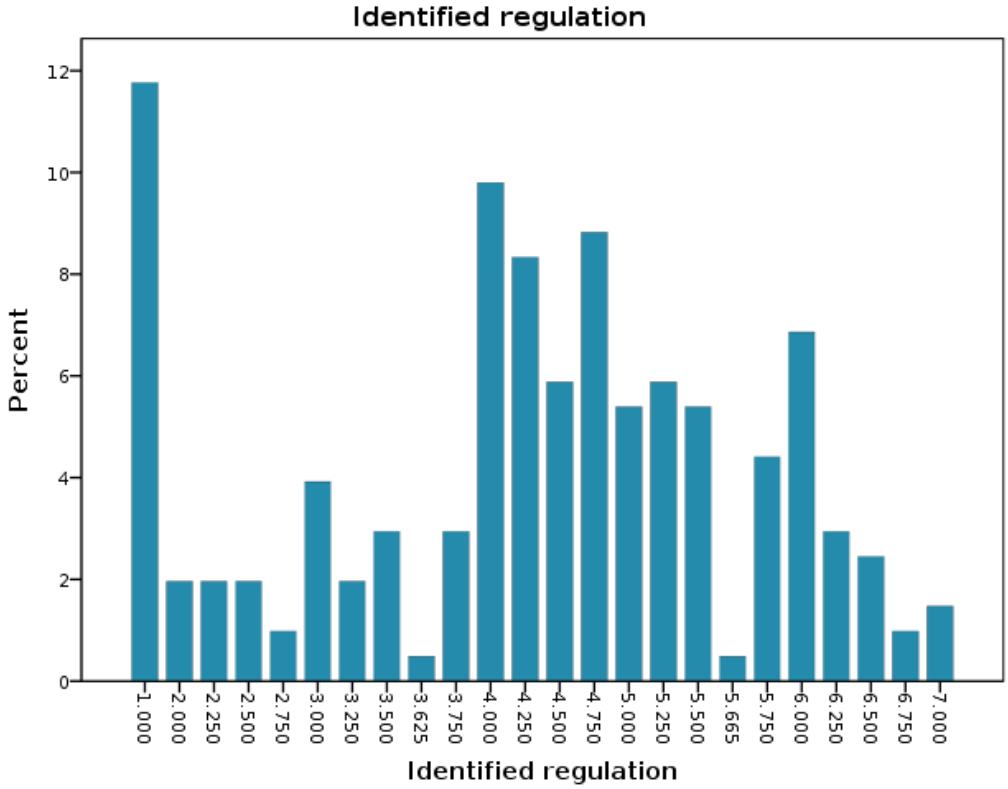


Figure 4. Frequency distribution of identified regulation

Students reports of external regulation were on average, high (*M* =4.76) with a high level of deviation among reports (*SD* = 1.65). It is worth noting, that the level of standard deviation becomes higher as we progress to less self-regulated forms of motivation.

Based on Figure 5, there appeared to be a cluster of occurrences where the level of external regulation was experienced as non-existent or very low. In 19 of the 204 reports (9,3%), the average rating of identified regulation was less than or equal to 2. This is, however, an even smaller cluster than that found in the identified regulation. Otherwise the reports appeared to be somewhat normally distributed and negatively skewed.

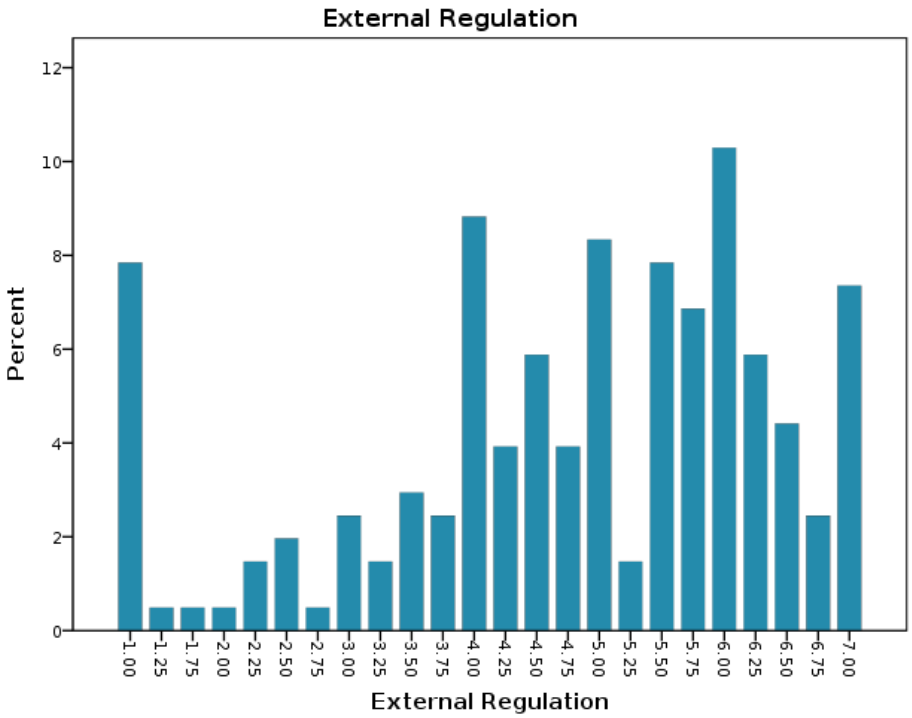


Figure 5. Frequency distribution of external regulation

Because of the low amount of reports per student, it is not possible to determine to what extent the high variation in reports is caused by individual or situational differences.

The results indicated that female students experienced, on average, more situational external regulation than male students by a small difference. A Mann-Whitney U test indicated that the level of external regulation was higher for female students (Md_{Female} = 5.5) than for male students (Md_{Male} = 4.6), U = 3972.50, p = .005, d = .43. This exceeds Cohen's (1988) threshold of moderate effect (0.4-0.7).

There were no statistically significant gender differences in averages of either intrinsic motivation (Md_{Female} =3.75, Md_{Male} =4.50, U =4988.00, p =.695) or identified regulation (Md_{Female} =4.00, Md_{Male} =4.25, U =4661.00, p =.241).

5.1.1. Time to Deadline

Students were more active in their collaboration when the deadline came near. Collaborative acts appeared to happen most in the days leading up to the next deadline, with the average time to the upcoming deadline being, M =3.26 SD

=3.67. All tasks were assigned to students a minimum of 7 days before the respective deadline.

The proximity of a deadline did not appear to have an effect on how students saw the reasons for their activity. No statistically significant correlations were found between the motivational constructs and the time remaining to the next deadline (IM: r_s = .058, p = .41; IR: r_s = .001, p = .988; ER: r_s = -.043, p = .55). A visual inspection of the scatter plot did not reveal a non-monotonic relationship between the motivational types and the time to deadline either.

5.1.2. Progression in course

There was no evidence of students' motivational experiences changing in type as the course progressed. The results found no significant correlation between the progression of the course and the motivational constructs (IM: r_s = -.026, p = .71; IR: r_s = .078, p = .266; ER: r_s = -.066, p = .52). A visual inspection of the scatter plot in the first phase of the analysis did not reveal a non-monotonic correlation between the motivational types and progression in the course, which is further evidence for a lack of correlation.

5.2. Patterns of social interaction

To determine the structure of the learning community that arose during the course, a total of 2802 chat messages sent to and from students were retrieved from the learning system's database and analyzed.

5.2.1. Emergent social structure and cohesion

The origin and amount of messages were mapped into a social network graph using methods of force-directed node placement (Fruchterman & Reingold, 1991; Jacomy, Venturini, Heymann & Bastian, 2014). The emergent visualization of the structure of the social interactions during the course can be found in figure 6. In the image, nodes (circles) signify students, their size how much they participated in the interaction (bigger indicates more participation) and their color their level of centrality (darker indicates a higher level of centrality). The lines between nodes signify the extent to which the students interacted with each other (curved to the

right from the perspective of the sender). Thicker lines indicate more messages sent.

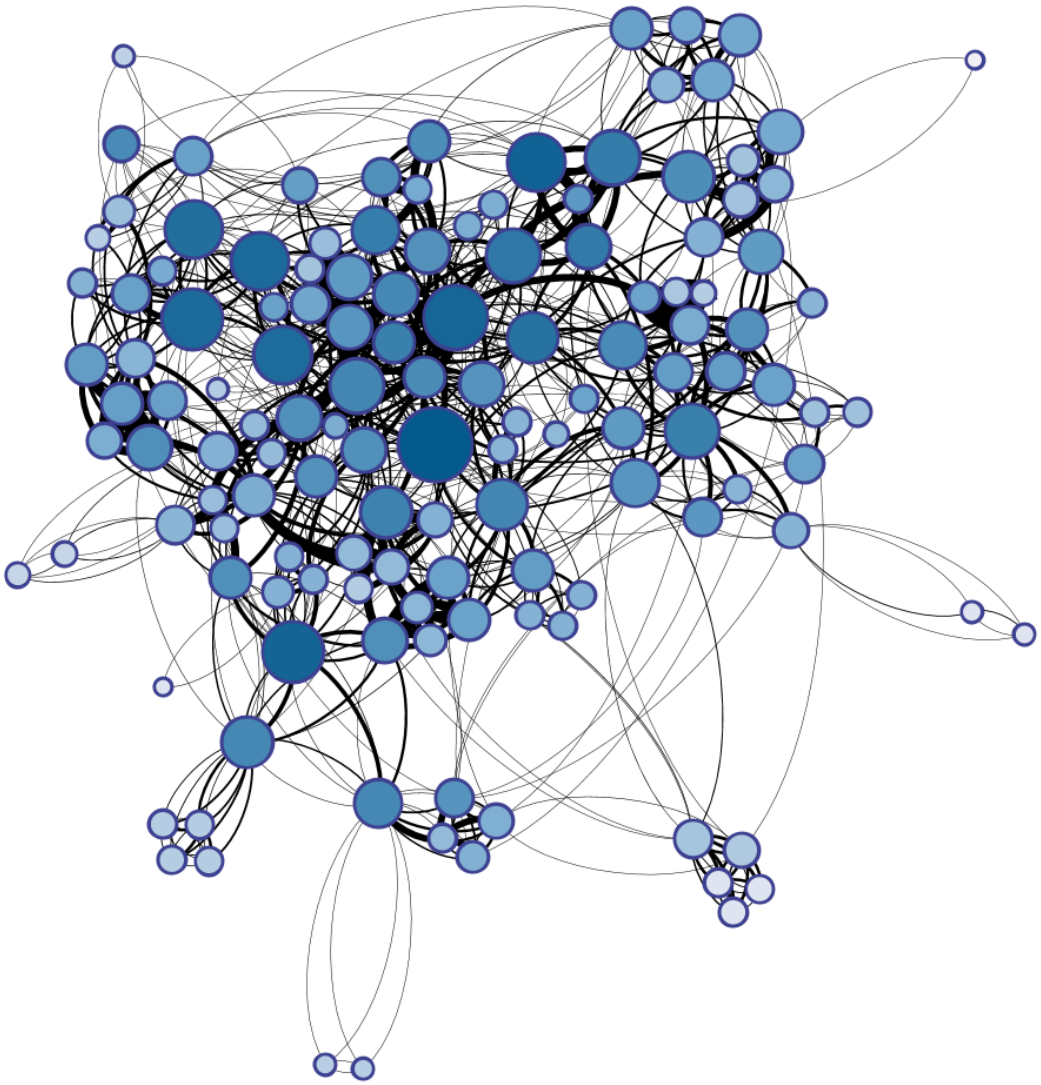


Figure 6. Social network graph of interactions during the course

The patterns of interactions indicated that there subgroups within the large group. This is based on visual inspection of graph X and the density of the social network, which was calculated to be 0.05. In a weighted network, the density signifies the average tie strength across all possible ties (Newman, 2004). This can be considered a fairly low level of density, probably caused by students mostly communicating within their own group and very little outside of it. This assumption is supported by the high level of modularity in the network (0.72), which signifies

how well a network decomposes into modular sub-communities (Blondel, Guillaume, Lambiotte & Lefebvre (2008). It too supports the view, that within the large group formed by all the course participants, there were a number of smaller subgroups.

There was some indication of a so-called small-world effect, based on that the average clustering coefficient in the network was fairly high (0.637) while still having a somewhat high mean shortest path between nodes (3.26) (Watts & Strogatz, 1998). These measures mean that if a student A communicated with students B and C, then it is likely that B and C also communicated with each other. The path length signifies by how many other students, on average, students were separated from each other in the network (Watts & Strogatz, 1998).
The two students who were furthest away from each other in the network, were separated by 6 other students.

5.2.2. Participation in socian interaction

On average, students used the chat messaging function moderately often (*M* =115.5, *Md* =75, *SD* =130.3). As can be seen in the frequency table (Figure 7) the here was a high level of deviation in how much students used the function which is to be expected based on earlier studies, individual differences and the course structure. The most active student sent a total of 454 messages, whereas the least active student didn't send a single message. The high standard deviation signifies a clear heterogeneity in the level of participation in social interaction.

Figure 7. Student frequencies by messages sent

5.3. Relationships between social structure and situational experience

Overall, there was some ambiguous evidence for a connection between the patterns of social interaction and the reported situational motivation.

5.3.1. Situational motivation and participation in social interaction

The results indicated no correlation between what type of situational motivation the students experienced and how much they interacted with the other students as measured by chat messages sent. There was no significant correlation between any of the three measures of motivation and participation in the social interaction during the course (IM: r_s = -.082, p = .244; IR: r_s = -.002, p = .975; ER: r_s = -.124, p = .078).

5.3.2. Situational motivation and social position

Students who reported as being more intrinsically motivated in collaborative situations were less likely to occupy a central position in the social network. This was indicated by a faint negative relationship between intrinsic motivation and **centrality**, r_s = -.167, p = .022.

This same relationship was not present for identified regulation (r_s = -.087, p = .234) or external regulation (r_s = -.120, p = .100)

Students who experienced intrinsic motivation were also less likely to be in a position where they distribute knowledge between subgroups. This was indicated by a negative relationship between **betweenness centrality** and intrinsic motivation, r_s = -.205, p = .005.
This relationship was not found with betweenness centrality and identified regulation (r_s = -.130, p = .074) or external regulation (r_s = -.066, p = .370).

5.4. Summary

In summary, the data indicated that students experienced more extrinsic forms of motivation than intrinsic when deciding to collaborate with other students. There was a high level of variation in the level and type of motivation, which can be due to either situational, contextual or individual factors.
No evidence was found for the type of motivation changing as the course progressed or as deadlines were approaching.
Female students experienced more extrinsic motivation than male students by a small difference.

The social structure that emerged from the social interactions was very clustered, indicating that sub-groups emerged during the course. Overall, the network was not very dense, indicating that students did not interact with a wide range of other students but stuck to interacting with few of the other students.

Students participated, on average, moderately in the social interaction with the other students by sharing materials, chatting, commenting and asking questions. There was a very high degree of variation in how much students participated in the social interaction. Some sent nearly 500 messages, whereas some didn’t send any.

No significant correlation was found between the participation in social interaction and experiences of motivation.

Experiences of intrinsic motivation were found to be weakly negatively related to both centrality and betweenness centrality in the social network. This means that students who reported intrinsic motivation were less likely to be central figures in the learning community and also less likely to be a person connecting subgroups within that community.

6. Reliability and validity

In a study of this nature, important measures of quality are validity and reliability (Shrout & Lane, 2012). A valid study is one that measures what it claims to measure and a reliable one which results are replicable in similar circumstances.

The measure for situational motivation used in this study, the Situational Motivation Scale (SIMS; Guay et al., 2000) is based on on the self-detemination theory of motivation. Much of the research regarding the self-determination theory has been done in the learning space, including a higher education and CSCL contexts. The SIMS measure has been validated by earlier studies in several contexts, including the higher education context (Guay et al., 2000).

In order to confirm that the results of this study correspond to the theoretical foundation of the measure, the self-determination theory (Deci & Ryan, 2000), the relationships of the different measures were analyzed. By controlling for one of the motivational measures on the relationship between the two remaining motivational measures, the partial correlations presented in table X were found. These indicated that, in accordance with the self-determination theory, that motivational measures that have a similar level of self-regulation correlated significantly with each other while no such relationship was found between intrinsic motivation and external regulation.

	Intrinsic motivation	Identified regulation	External regulation
Intrinsic motivation	1.000	.777*	-.049
Identified regulation		1.000	.275*
External regulation			1.000

* significant at the $p < .001$ level

Table 2. Partial correlation of motivational measures.

In order to avoid measurement error stemming from misinterpreted questions or other confusion, a small pilot was carried out by asking 3 students not part of the sample to fill out the questionnaire. Pilot studies have been found to be beneficial for the reliability of a quantitative study (Patel & Davidson, 2003). Feedback was then collected on the comprehensibility of the statements and the instructions. No

improvements were needed based on this pilot. Participants were provided with contact information to the researcher at the outset of the study and instructed to contact him in case they had any questions or comments regarding the questionnaire. None of the participants contacted the researcher in regard to the questionnaire.

The Cronbach's alpha measure is appropriate for determining internal consistency in studies that employ continuous sampling not intended to measure within-person variation (Shrout & Lane, 2012, p. 304). Cronbach's alpha values yielded of the SIMS measure in this study were very high (IM α = .93; IR α = .90; ER α = .89), clearly exceeding the commonly employed .70 threshold (Nunnally, 1978). This indicated a high degree of reliability in the measure used.

7. Discussion

The aim of this study was to analyze students' motivation to collaborate in an online course. This was studied through event-contingent sampling of motivation at the time of collaborative acts (context-sensitive ecological momentary assessment) and through analyzing the patterns of social interaction (social network analysis). The data included 219 samples of situational motivation to collaborate using the Situational Motivation Scale (SIMS; Guay et al., 2000) and 2802 chat messages.

This chapter includes a brief discussion of the main results, parallels to earlier research, methodological reflections, an account of the limitations and some suggestions for further research.

Perhaps the most important result of this study, is that in this online course, students collaborated more due to extrinsic motivational factors than intrinsic. The situational measurements found, that the less self-regulated motivational types were on average more present when collaborating.

In a review of earlier research, no other studies were found that had measured the situational motivation to collaborate in a similar context or manner. Studies that measured contextual motivation (e.g. motivation towards their studies overall) have suggested that participation in collaborative learning is driven by intrinsic motivation, although with inconsistent results across studies (Rienties et al., 2008; Giesbers et al., 2013; Giesbers et al., 2014). Based on the results of this study, it seems that collaboration was not driven consistently by intrinsic motivation on a situational level. Situational experiences did not appear to be related to participation in social interaction.

Participation in social interaction was, on average, moderately high but had big individual differences. Students sent on average 116 messages during the course. In comparison to most other studies, this is a high level of participation. For example Caspi et al. (2003) observed a total of max 10 messages per student during a course and Guzdial & Carroll (2002) found that students sent on average 1 message per week in an overview of several different studies. The high level of participation in this study can be attributed to the structure of the course which

encouraged interdependence among the participants (Blumenfeld et al., 2006) and the affordances provided by the learning platform (So, 2009).
Palonen & Hakkarainen (2000) also observed a high level of individual differences in the participation in the discussion. In their study, this was to some extent explained by gender differences in their preferred way of participation. This could not be confirmed or disputed in this study.

The learning community as a whole in this study was fairly clustered and modular, indicating that there were subgroups. The majority of the interaction appeared to be between peers (as opposed to between teachers and students) and information flowed from different parts of the learning community. Content was generally only shared with other members of a small group defined by course staff, but some exceptions were observed where it was shared to other groups or all course members.
Based on the triggered experience questionnaires, very little feedback was given on shared materials in the form of comments or questions, indicating a lack of peer feedback among students. Students asked very few questions of other students.
Due to the course structure, students were in most assignments not directing their own inquiry but were free to self-organize. Some situational leadership is likely to have arisen in the subgroups but only as tied to a specific assignment. Knowledge is unlikely to have been collaboratively developed over the duration of the course, as it was not observed in the space (Gee, 2004) constituted by the learning platform. Based on these observations, there were few indications of learner-directed knowledge-building that would constitute a community of practice (Wenger, 1998) or an affinity space (Gee, 2004). Some autonomous content selection, self-organization and interest driven inquiry was observed but not enough to constitute interest-driven affinity, let alone shared identity. This was likely caused by the moderately heavy scaffolding and students' socialization into teacher-driven inquiries from their earlier studies. Although it is easy to criticize the effect of scaffolding on the learner's autonomy, it has proven pedagogical efficiency in creating fruitful collaboration even in much more intrusive forms of scaffolding (see for example research on collaboration scripts; Miao, Hoeksema, Hoppe & Harrer, 2005). The efficiency of the method depends on the learning goals of the course,

where knowledge-retention driven goals favor methods that liken constructive design (Biggs, 1996).

Experiencing intrinsic motivation to collaborate on a situational level was related to having a more peripheral social position in the learning community. Experiences of situational intrinsic motivation were negatively correlated with both centrality and betweenness centrality in the social network that formed during the course. The correlation was statistically significant but not substantial (centrality, r_s = -.167, p = .022; betweenness centrality, r_s = -.205, p = .005). This result is surprising considering the results of some earlier research that has found a positive relationship between intrinsic motivation and centrality in learning groups (Rienties et al., 2008).

It is unclear what the direction of causality is in this correlation. One option is that having a less central position affects the student's motivational experience in the situation. Another option is that students who experience intrinsic situational motivation to collaborate are less likely to engage in conversation with a variety of students, thus making them have a less central position in the social network.

Regarding the latter option (the motivational type causing the position), there have been reports of preferential attachment among intrinsically motivated students. In practice, this meant that students who were intrinsically motivated were more likely to converse with other intrinsically motivated students (Rienties et al., 2008, p.13). As the situational motivation among learners was dominantly extrinsic during this course, intrinsically motivated students may have been "put off" by the motivational orientations of the other students and retracted from participating in a central role in the discussion. Further research is needed to determine whether or not preferential attachment is common in other contexts and what it is caused by. This is an important matter, as having a central position in the social structure is correlated with positive learning outcomes (Russo & Koesten, 2005) and it is not desirable to foster communities that alienate intrinsically motivated learners.

Upcoming deadlines and progression in the course did not appear to affect the situational motivation to collaborate. There was no significant correlation between

the different types of motivation and the time to the next deadline and the motivational types did not appear to change over the duration of the course. Amabile et al., (1976) suggested that the situational motivation to learn overall is affected by deadlines. This may be true in spite of the results found in this study, but it seems the effect is at least not progressive as the deadline approaches.
Rienties et al. (2008) suggested that intrinsically motivated students (on a contextual level) would become more intrinsically motivated to collaborate as a course progressed due to a positive feedback loop, while extrinsically motivated students would experience the opposite. Neither of these effects were found in the the data of this study.

7.1. Limitations

The aim of this study was to analyze students' situational motivation to collaborate in an online learning context. The motivational measure that was used in this study (Situational Motivation Scale; Guay et al., 2000) measured motivational types on a situational level based on the structure defined by the Self-Determination Theory of motivation (Deci & Ryan, 1985a). Although the measure itself has been extensively validated, it does not measure all motivational types listed in the Self-Determination Theory. This study measured intrinsic motivation, identified regulation and external regulation. The Self-Determination Theory also includes integrated regulation, introjected regulation and amotivation.

This study also had a relatively small sample of situational motivation measurements, considering that 219 surveys were completed by 179 students. This limited sample does not allow analysis of whether differences in motivation are mainly individual or situational. Also, most questionnaires were triggered by students sharing materials (not by responding to comments or asking questions) which may affect the generalizability of the results.

The level of participation in social interaction was, in this study, measured by how much students used the chat function afforded by the learning platform. The chat

was used quite often (see chapter X) but students may have used other means of communication in addition to it. These would not have shown up in the analysis.

Although studies that span the duration of a course are common, Hakkarainen (REF) suggested that in order for us to better understand computer-supported collaborative learning, longer studies need to be employed. Although this study found no progressive differences in motivation, it is likely that patterns of interaction and motivational experience would become clearer in a longer study spanning several courses.

7.2. Methodological reflections

In this study, experiences were studied using an active method of data collection and social interaction using passive data collection. Both methods were quantitative but different in the information they provided.

The CS-EMA method assesses subjective experience, whereas the SNA method assesses observed behavior. One might think that this constitutes an epistemological contradiction, where observational data is rooted in behaviorism and the experiential assessment are, on the other hand, phenomenological in nature.

In this study, the two methods that were used provided complementary viewpoints that enrichen the view of the phenomenon that is studied. In recent years, using a variety of methods in studies has become commonplace in CSCL research (see for example Martinez et al., 2006) and makes it possible to use methods that are most apt to answer the research questions at hand, independent of epistemological foundation. Although this does not resolve the philosophical conflict, there are clear practical benefits.

Next, the merits of both methods will be discussed separately, starting with the sampling of motivation and followed by the social network analysis.

Although motivation as a construct has been found to be situationally dependent and fluid, measurements of motivation related to collaboration have mostly been done on a trait and contextual level (Hartnett et al., 2011). Järvelä et al. (2008, p.122), among others, highlighted the need for studying CSCL phenomena in their real context, as they occur.

In this study, this was achieved through context-sensitive ecological momentary assessment (CS-EMA; Csikzentmihalyi, 2013; Intille, 2007). In practice, this meant that situational motivation surveys were triggered by collaborative acts performed by students when they were studying. The participants saw a pop-up window with the questionnaire (see Appendix A).

These event-contingent methods have been found to be especially suitable for studying subjective experience and social interaction (Scollon et al., 2003; Csikzentmihaly, 2013), making them optimal for answering the research questions in this study.

The situational measure used in this study (Situational Motivation Scale; Guay et al., 2000) was short, only containing 12 multiple-choice items. Using a short measure was intentional, chosen to avoid disrupting the learning process unnecessarily. This has also probably motivated respondents to make the effort to fill out the questionnaire more often, as responding was not incentivized in any way. Based on feedback from the pilot study and from the participants, the questionnaire was found to be easy to fill out and only a minor inconvenience while studying. Most questionnaire entries were complete, while a few lacked an answer to the fourth claim (*"Because I think this activity is pleasant"*). This answer missing appeared to be consistent in that the same respondents left it unanswered in every entry. This is assumed to be caused by respondents not understanding the word *pleasant*. This should be taken into account in future studies of non-native english speakers.

The second method, social network analysis, has been found to be uniquely useful when analyzing social structures and participation in computer-supported collaborative learning (Nurmela, Lehtinen & Palonen, 1999). As the data of participation in social interaction and the emergent social structure was collected directly from the logs of the learning platform, it corresponds to actual behavior carried out in the system. This avoids memory bias and missing data, which are often present in retrospective data collection (Cikzentmihalyi, 2013; Scott, 2007). In spite of the benefits of using event logs directly from the virtual environment, it still seems to be fairly uncommon. This could be due to it requiring access to

database and some technical work, such as data queries and programming to transform the data into a format that is accepted by software used for analysis.
In this study, the social network analysis used the most common individual-level measures in the research tradition; outdegree, Freeman's centrality and Freeman's betweenness centrality. Collective-level measures used were density, modularity and clustering. These provided general information of the learning community as a whole, which contributed to the motivational analysis by providing context.
Additional measures that could have been used were measures of reciprocity and homogenity in social interaction. These were discounted because the analysis software used did not offer these options and would have needed to be programmed by hand.

7.3. Suggestions for further research

In this study, the situational motivation was analyzed with variable-centered methods, which aim to find generalizable relationships between different variables. In future research, a person-centered approach would provide complementary information. Using situational, contextual and trait measures of motivation (such as the SIMS; Academic Motivation Scale, Vallerand et al., 1992; General Causality Orientations Scale, Deci & Ryan, 1985b) and measures of social participation would provide information on the interplay of different (trait, contextual, and situational) levels of motivation and their relation to social interaction.

This study spanned the duration of one course. By extending the study over several courses, the generalizability could be improved and the effects of the course structure could be analyzed in relation to the participation in collaborative learning. This could also describe motivational changes over time to see whether or not there are sustained or progressive changes.

In future situational analyses, time-specific contextual measures would provide information on how the environment affects the student's experience and behavior. By analyzing the situational experiential and behavioral factors in relation to time-specific environmental factors, one could establish relationships of causality

between environmental factors and individual factors. As an example, it would be fruitful to analyze from moment to moment, if the motivational experience of a student changes based on who they interact with (thus indicating socially shared regulation; Hadwin, Järvelä & Miller, 2011).

This study analyzed message frequencies and the social structure they created. As Paavola et al. (2002) stated, there are, however, clear differences in the quality of interaction. Some but not all interaction is knowledge building. Future studies could analyze the extent to which knowledge building dialogue is related to motivational experience. This can, to some extent, be done automatically to manage the large samples of messages that may arise, as suggested in Ferguson & Shum (2011).

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Appendices

Appendix A: Context-Sensitive Questionnaire

The Situational Motivation Scale (adapted from Guay et al., 2000, p. 210) used in the Context-Sensitive Ecological Momentary assessment measuring intrinsic and extrinsic motivation.